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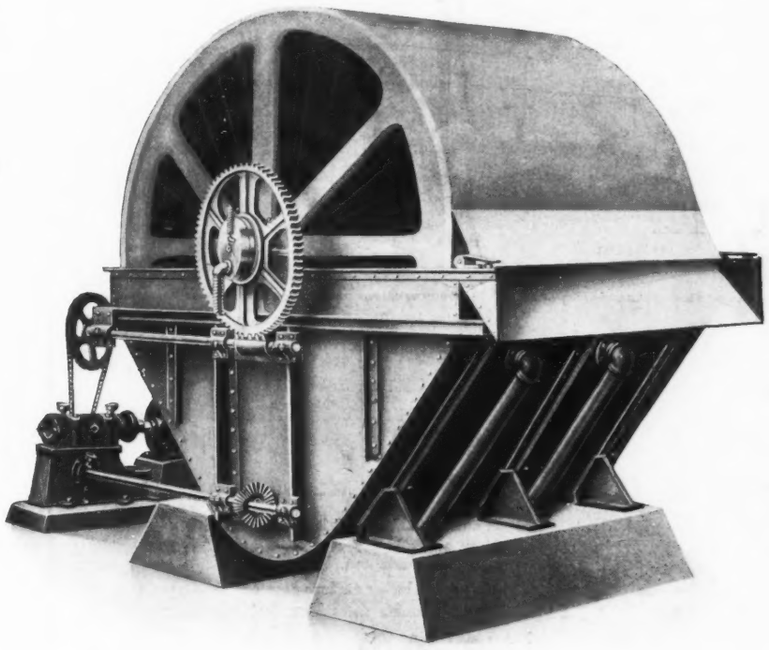

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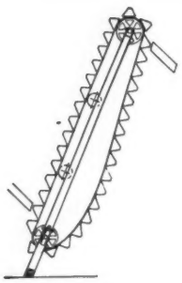

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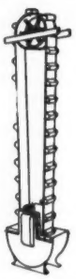

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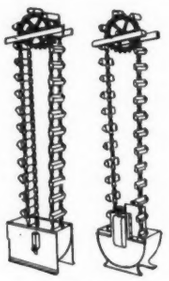

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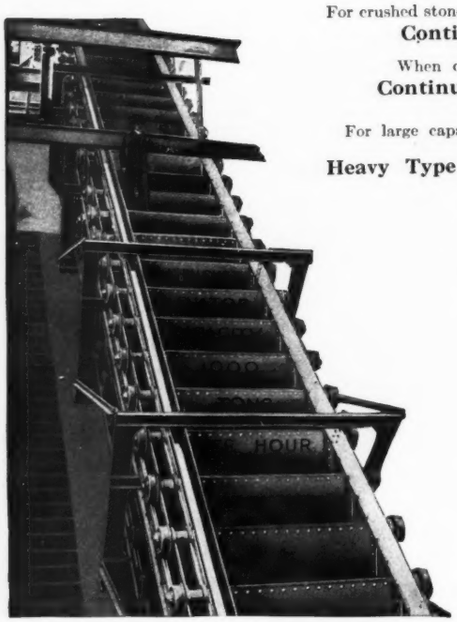

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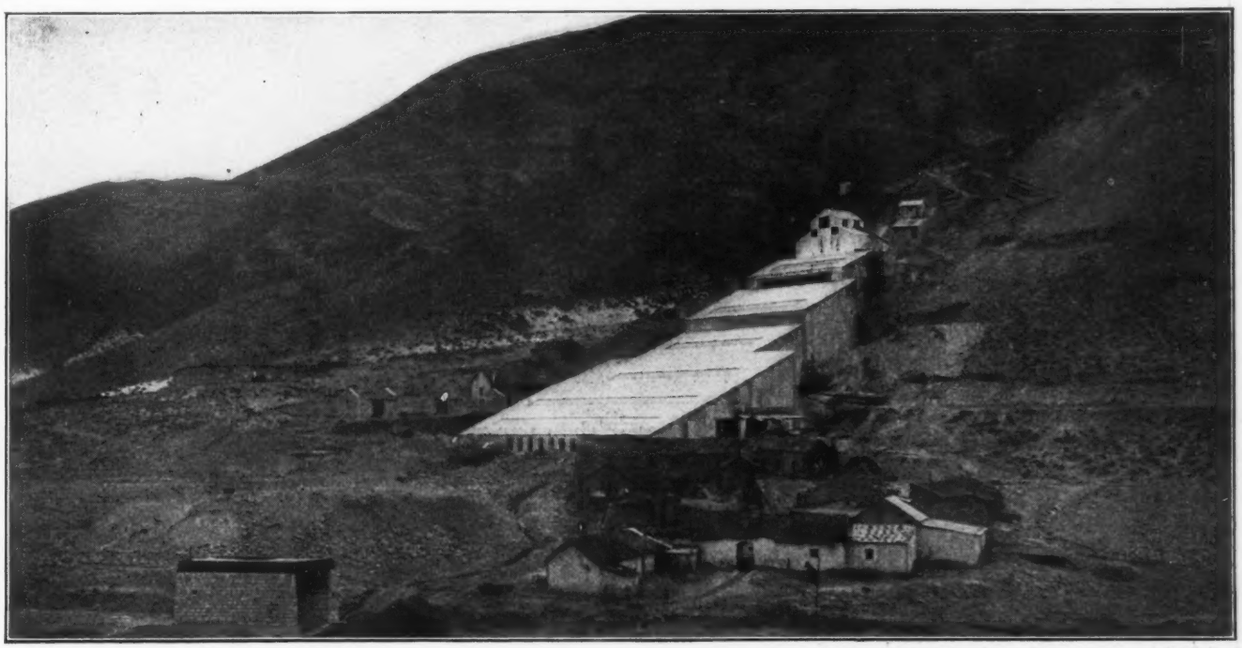
New Developments in the Porco District, Bolivia

By Joseph T. Singewald, Jr.,* and Benjamin LeRoy Miller†

SYNOPSIS—The Porco mines were among the first to be worked in Bolivia for silver and are now being worked for tin, the silver-bearing high-grade veins having been worked out. At present operations are conducted by the Porco Tin Mines, Ltd., on wide-vein low-grade oxidized tin ores. Concentration in a 120-ton mill is practiced and barilla shipped.

The Porco mines are said to be the first in Bolivia worked by the Spaniards, and the neighboring but more famous district of Potosi was discovered in 1544 by a miner from Porco. Like Potosi, it was originally a silver camp of considerable importance, but the rich silver ores were soon exhausted and there came a long period during which the mines were practically abandoned; hence, when in later years mining was resumed, titles were taken according to the Bolivian law and the old *boca mina* law, still in force at Potosi, no longer exists here. In recent years tin mining had been conducted in a more or less desultory way by Bolivians who had a mill for treating the ores at Agua Castilla, which extracted both silver and tin. These operations have now been superseded by those of the Porco Tin Mines, Ltd., which company acquired the properties in 1912.

The chief mineralized area is confined to a mountain mass culminating in a peak of about 17,000 ft. elevation called Apo Porco and having as one of its spurs a smaller and lower peak known for that reason as Huayna Porco. Both of these peaks are mineralized but, as will be described farther on, in a different manner. The town of Porco is a small Indian village lying near the mouth of a gulch at the foot of the mountain on the opposite side of Huayna side of Huayna Porco from the mines. It is a most primitive and picturesque place, consisting entirely of crude houses built of boulders collected from the stream and hill slopes and covered with thatched roofs. In many of them the inhabitants have not even taken the trouble to fill the crevices between the stones with mud, so that the house affords only



THE AGUA CASTILLA MILL IN THE PORCO DISTRICT, BOLIVIA

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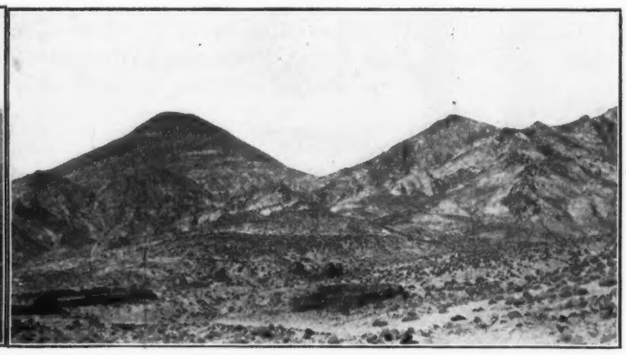
partial protection against wind and cold. The railroad from Rio Mulato to Potosi that was opened in 1912 passes only 5 km. from the mines and the town, the station for both of which is Agua Castilla, 114 km. from Rio Mulato and 60 km. from Potosi, and the only station on the entire line. These improved transportation facilities made the development of the Porco ore deposits along the lines of a low-grade, large-scale proposition possible and resulted at once in the application of foreign capital to that end. It is believed that the Porco Tin Mines, Ltd., is closely affiliated with the Aramayo Francke Co., Ltd., interests.

The impression one receives of the geology of the country in traversing it on the railroad is rather erroneous. The train leaves Rio Mulato every Saturday morning at 8:25. For a short distance the road traverses the *altiplanicie,* skirting several knolls of igneous rock that rise above it, and then enters the Cordillera Real for the rest of the journey. The train climbs continuously until about one o'clock, when the highest point on the line is reached at an elevation of 15,814 ft., more than 3000 ft. above Rio Mulato and the highest point on any Bolivian railroad. From here there is a rapid descent of over 2000 ft. to Agua Castilla, reached about an hour later. The rock seen along the entire route consists of light-colored volcanics carrying abundant biotite and quartz phenocrysts, and apparently rhyolitic in composition.

The ridge at the foot of which the Agua Castilla mill is situated is capped by an igneous flow that manifests considerable difference in appearance from place to place, but which in general is characterized by an abundance of biotite, a varying amount of quartz, and feldspar phenocrysts that are chiefly orthoclastic, and consequently seems to range in composition from rhyolite to trachyte. Underlying this flow is a heavy, distinctly cross-bedded sandstone, the one previously mentioned, which readily disintegrates and has yielded a large amount of sand that has accumulated in the form of dunes in the direction of Porco. Beneath the sandstone on the road from the mill to the mines are several small exposures of a dark gray to black shale. On the northeast, east and south sides of Apo Porco, the igneous rocks of that mountain are in contact with a very heavy quartzite, in which the bedding is not very distinct, but which, in so far as it can be recognized, is that of a heavy, cross-bedded sandstone. As no other quartzite of this character was seen in the region, it seems probable that it represents a local metamorphosed phase of the friable sandstone previously mentioned.

The two mountains, Apo Porco and Huayna Porco, are composed entirely of igneous material. Their lower parts are composed of quartz porphyry, rhyolitic tuff and agglomerate. The agglomerate in particular is characterized by an abundance of shale fragments, and

OPENCUT ON THE SAN JOSÉ VEIN



APO PORCO AND HUAYNA PORCO

Some phases of the rocks represent compact porphyries, others are more pumaceous in texture. A short distance before reaching Agua Castilla, in the walls of a deep gorge on the south side of the track, we saw some excellent examples of columnar structure in the volcanics. Just beyond Agua Castilla, on the way to Potosi, for a short distance an area of tan-colored, heavy, cross-bedded sandstone is passed through, after which only igneous rocks are again encountered until near Potosi. The impression gained from the railroad is that of a vast area of prevailingly igneous rock. Quite the reverse are the true relations unfolded by the magnificent view from the top of Apo Porco, from which the famous mountains of Potosi, Tasna and Chorolque are visible. The country that spreads out for miles before one is seen to consist for the most part of sedimentary rocks, the bedding of which is distinctly visible on the almost barren hills. Here and there are igneous intrusions and cappings of lava, some of considerable areal extent, but the whole constituting a minor part of the terrain. It is mere chance, therefore, that the railroad throughout nearly its whole extent traverses igneous rocks.

only a few sandstone or quartzite fragments were noted, indicating that the underlying rock consists of the dark shales, chiefly Paleozoic in age, that constitute such a large part of the eastern range of the Andes in Bolivia. The summit of Apo Porco appears to be entirely devoid of mineralization and consists of a quartz trachyte with large feldspar phenocrysts, some of them as much as 2 in. long, and is almost devoid of foreign inclusions.

The chief mineralization has taken place within a very restricted area that includes Huayna Porco and the adjoining portions of Apo Porco; especially that portion on the east side of Huayna Porco. By far the greater part of the mining in the past was done on Huayna Porco, which in places is almost as completely covered with old mine dumps as is Potosi Mountain. The reason for this is that the veins are argentiferous and in colonial days yielded rich silver ores. They are usually narrow, run in fairly straight lines and carry an ore consisting of high-grade argentiferous galena, sphalerite which is usually low in silver, and here and there pockets of ruby silver. The richest parts of these veins have long since been worked out, and they are today abandoned.

In contrast to the veins of Huayna Porco, those of Apo Porco are wide, carry but little silver and galena, in the sulphide zone contain mostly pyrite and in places considerable sphalerite, and are characterized by their tin content, which exceeds in value the silver. Mining in recent years has been confined to these ores. Most of the work has been done in the oxidized ores that are said to average 12 oz. silver and 2½% tin. The sulphide ores average much lower in tin, indicating a tin enrichment in the oxidized zone. No cassiterite was recognized in the sulphide ore, showing that it occurs in small particles in the primary ore. The same is true to a large extent of the oxidized ore, and where it is visible it occurs as minute black specks either in the soft clayey material of the gossan or as a thin coating on the surface of rock fragments. Very little *guia,* as the high-grade cassiterite that can be hand-sorted is called, is encountered anywhere in the veins. This manner of occurrence of the cassiterite makes it likely that the tin enrichment in the oxidized ore is to a large extent both residual and mechanical. The elimination of the sulphides of the primary ore would of itself cause a considerable relative enrichment in tin. The small particles of cassiterite liberated in the then porous oxidized material doubtless to some extent sift down through it and in this way add to that originally present, causing an actual increase in the amount of tin in the oxidized parts of the veins. Harold A. Lewis, manager of the mines, is also inclined to believe that concentration may have taken place in this way, and told us of another instance to which he gave the same interpretation. In the Berenguela district, Mr. Lewis said, the highest tin content is encountered in the sulphides under the oxidized ores. These sulphides are very porous and drusy, and the openings are filled with small particles of cassiterite which he believes is due to a mechanical downward migration. At Porco the migration was confined to the oxidized zone. It is quite possible that in the presence of the sulphuric acid and ferric sulphate generated in the oxidation of the pyrite, there may have been some solution and redeposition of the tin. This action is generally believed to take place to a limited extent in tin ores, however, so that the first explanation appears the more plausible.

Many Antimony Bearing Veins Occur

In addition to the mineralization of the Porco Mountains, there are a great many antimony veins in the shales of the surrounding country that were actively exploited during the recent high prices for that ore, and Agua Castilla was one of the principal shipping points of the Bolivian production during that period. Though the veins are comparatively narrow in most instances, the filling consists chiefly of stibnite, with only subordinate quantities of quartz, which is the most abundant gangue mineral, so that it is easy to secure hand-sorted stibnite with which is often associated a little antimony ocher carrying 50 to 55% antimony. The mines are small, crudely worked properties, generally operated by Indians. The latter prospect the mountains and, on locating a promising vein, bring samples to someone capable of financing the project and in return for permitting him to denounce the claims are given the privilege of working them and are paid by the quintal for the ore when delivered at the railroad. Many antimony-mine owners have never seen their mines. This procedure is due to the fact that the Indians lacking capital are forced to realize on their labor at once; whereas the owner of the property receives, as his compensation for advancing the money and waiting several months for settlements the wide margin between the price received by the Indians and the market price of the metal, which may be as much as 50%.

Mining Operations Conducted by Porco Tin Mines, Ltd.

The Porco Tin Mines, Ltd., is the only operator in the district, and its property includes the whole of the mineralized area of Apo Porco and a large part of Huayna Porco, but it is mining only the tin veins of Apo Porco. The mine offices are situated in the ravine between the two mountains on the north side of Apo Porco at the tunnel of the old Pie de Gallo mine, which was the most important of the silver mines on Huayna Porco. A short distance above the buildings is the tram terminal from which the ore is sent to the mill. Here the Dolores adit, the principal adit of the company crosscuts 800 to 900 ft. south to the principal vein, the San José. The vein on this level consists of heavy pyrite and carries only a fraction of a per cent. of tin and about 8 oz. silver. The country rock is agglomerate, tuff and quartz porphyry. Besides fragments of igneous material, the agglomerate and to a less extent the tuff are characterized by an abundance of shale fragments. A raise from this level serves as an ore course from the main San José level.

The San José adit enters the hill farther to the east and 72 m. higher than the Dolores. It is a 400-ft. crosscut to the west to the San José vein, which has been drifted on from it to the north and to the south. The Dolores connection is made in the north drift, and at the same point is a raise to the surface to connect with a surface tram that brings the ore from the Santa Rosa and Misericordia veins. The plan of mining the San José vein above this level is to glory-hole the outcrop and a series of raises 30 m. apart and extending to the surface that are to serve as ore chutes were about completed at the time of our visit. This level as far as developed is in the oxidized zone, though occasional patches of sulphides are encountered; but at the breast of the south drift the vein consists of small stringers of sulphide, chiefly pyrite, cutting a country rock very much impregnated with pyrite, indicating that the sulphide zone has been reached. A level 22 m. below the San José is practically at the contact of the oxidized and sulphide ores. The country rock of these workings is similar to that in the Dolores level, except toward the north end, where there is a very dark agglomeratic rock that looks as if it might be a dark mud flow that gathered up the included rock fragments.

The San José oreshoot developed in these workings has a length of about 150 m. and an average width of 2 m. The maximum width is near the south end of the outcrop, where a width of 20 m. is being removed for a short distance. The vein has a strike of N 10-20° E and a dip that changes from nearly vertical at the north end to much flatter southeasterly at the opposite end. It is not a simple fissure filling, but a lode fissure or shattered zone. In the sulphide zone, the veinlets are more or less distinct, though the intervening rock is impregnated with pyrite. In the oxidized zone, the pyrite has completely changed to limonite and the

adjacent country rock is thoroughly altered and iron-stained, so that the entire width of the lode fissure consists of the highly ferruginous, low-grade stanniferous, soft material that constitutes the great bulk of the ore. Some of it is of very smooth, uniform texture like kaolin and is stained a light to reddish yellow. Though usually soft, this material is in places silicified and hard. The San José dump will also be sorted, since it is found to yield a 2% ore that can be profitably milled.

A short distance south of the San José workings, a second oreshoot on the same vein is opened up by the Zuñiga level. This shoot is 30 to 50 m. long, averages 2½ m. wide and the ores run 3% tin. The importance of the San José vein is indicated from the fact that 80% of the developed ore of the company is in this vein.

Two other veins east of the San José and parallel to it in strike but with a steep westerly dip—that is, toward the San José—the Misericordia and Santa Rosa, are being developed. The Santa Rosa mine has an adit 400 ft. long, penetrating the hill in a southerly direction, and as the hill rises in this direction, the adit first passes through oxidized ores and then into the sulphide zone. The sulphide ores consist chiefly of pyrite, but contain also considerable sphalerite. The oxidized ores are of the same character as those of the San José. The vein averages about 0.7 m. in width. A surface tram connects the adit with the ore chute from the surface to the San José level of the San José mine, the difference in elevation of the two levels being 42 m.

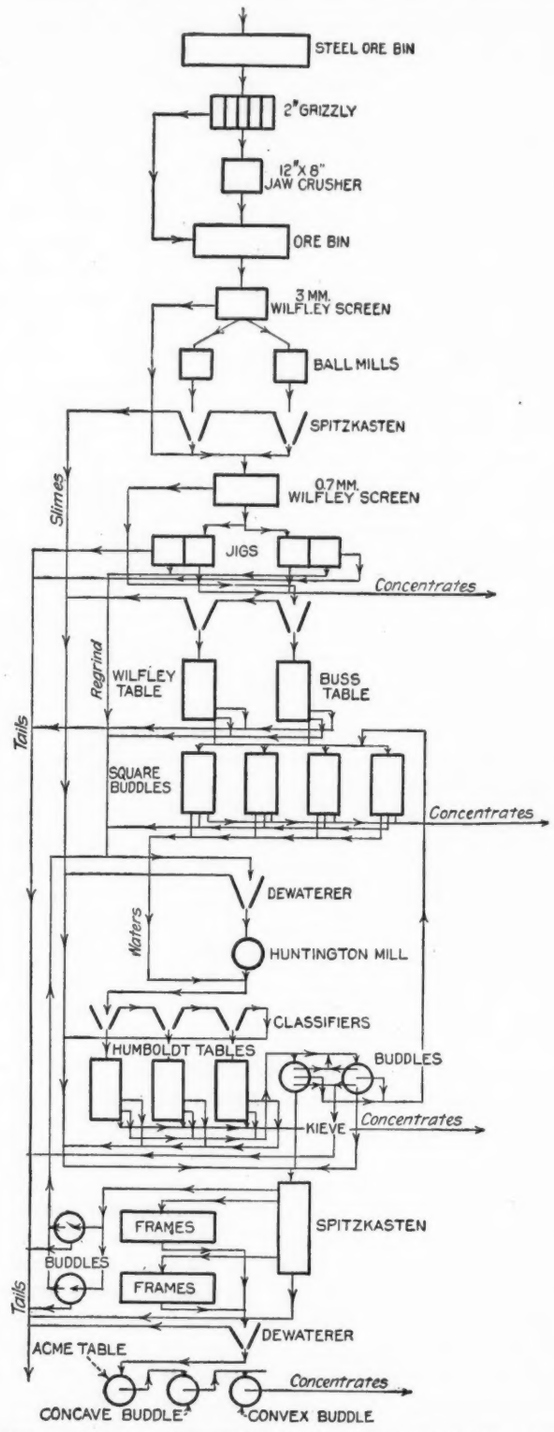
The Misericordia vein lies between the Santa Rosa and the San José, about 50 m. from the former. It is developed by an adit 45 m. higher than the Santa Rosa in the oxidized ores and a crosscut from the latter, which penetrates the sulphide zone, with a raise to the adit to serve as an ore course. The Misericordia is a fissure vein of less than 1 m. in average width and filling consisting chiefly of sphalerite, in places almost pure coarsely crystallized dark zinc blende, mingled with more or less pyrite and locally a little galena. One face of such ore showed 3% tin, but in general the tin content of the sulphides is much lower. The oxidized material differs from that of the other two veins in being of distinctly red instead of yellowish color and is said to run higher in tin. In addition to the three principal veins described, there are a number of others on the property.

Milling at the Agua Castilla Mill

The mine workings are all connected in such a way that the ore is brought through the Dolores adit to the aërial tram terminal close to its portal. The tram is of the single-cable type 4200 m. long, the longest span of which is 1082 m. Since the mill terminal is only 240 m. below the mine terminal, which has an elevation of 13,400 ft., and there is an intervening ridge 220 m. higher than the latter gravity does not suffice to operate the tram and must be supplemented by a 15-hp. motor. The buckets have a capacity of 400 lb. The cost of the tram was £8000. At the mill are an automatic counter and scales.

The mill is situated 1 km. east of Agua Castilla station on the north side of the railroad, from which it is served by a siding, and was completed in June, 1915, at a cost of £25,000. It is run by water power furnished by a 222-m. head. A small reservoir in the ravine back of the mill, supplying the flume, is fed by a spring called Agua Castilla on account of the clearness of its water, which furnishes a flow of 3½ in. over a 3-ft. weir from a point 60 m. higher up.

The mill is constructed in two similar units, only one of which will be described. On arriving at the mill, the ore is dumped into a 60-ton steel bin, from which it is



FLOW SHEET OF ONE SECTION OF AGUA CASTILLA MILL

run over a 2-in. grizzly and the oversize after removing the larger masses of barren rock fed to a 12x8-in. jaw crusher. The entire product goes to a second bin, which feeds a 3-mm. Wilfley shaking screen the oversize of which is ground in two ball mills and the undersize passes to a second Wilfley screen of 0.7 mm. mesh. The ball mills

are equipped with 1-mm. screens, and the pulp from each is classified in a spitzkasten. The overflow goes to the slimes launder and the settlings to the second screen.

The screen oversize is distributed by a launder classifier to two 2-compartment Harz jigs. The feed of the coarse jig is considerably higher in tin than the unclassified material, a 2½% ore giving a coarse feed with 5% tin. The screens of the first and second compartments of the coarse jig are 2 mm. and 3 mm. respectively and of the second jig 1.7 mm. and 2 mm., and pyrite is used for the bedding. Concentrates with 55% tin, middlings that are reground in a Huntington mill and tailings that go to the creek are produced by the jigs. The screen undersize goes to a pyramidal dewaterer, the settlings of which are treated on a Buss table and the overflow in a second dewaterer, the settlings in turn being treated on a Wilfley table and the overflow going to the slimes launder. The tables yield a 35% concentrate which is rewashed by hand on four square buddles, the tails from which are reground and the waters added to the regrind pulp, middlings that are dewatered and reground and the waters passed to the slimes launder, and tailings carrying 0.3% tin which go to the creek.

The Huntington mill has a 0.7-mm. screen, and its pulp flows through a series of three pyramidal settlers for classification, each of which feeds a Humboldt table, and the overflow the slimes launder. These tables make a concentrate that is re-treated in a kieve, waters that go to the slimes launder and an intermediate product that goes to two buddles with revolving arms. The heads from these buddles are re-treated on the square buddles, the middlings in the same buddles, the tailings go to the creek, and the overflow to the slimes launder.

The slimes launder empties into a long spitzkasten at the bottom of the upper end of which is a spigot to catch any sands the slimes may contain. Such sands are treated on two buddles to the left of the frames which yield heads carrying 1 to 2% tin that go to the regrind, the tailings and overflow being discarded. The spitzkasten also has two spigots for slime settlings, each of which feeds a row of 10 frames. The overflow from it goes to the creek. The concentrates from the frames go to a settling tank the overflow of which is also discarded and the settlings sent to an Acme table. The concentrate of this table is further treated in a concave buddle and that of the concave buddle of each unit of the mill in a single convex buddle.

Plant Exceeds Designed Capacity

The mill was originally designed to treat 80 tons of ore daily, but the one unit in operation at the time of our visit was handling 50 tons and could take care of 60 tons, so that the plant really has a capacity of 120 tons. The mill feed averages 12 oz. silver and 2½% tin. Operations had not been under way long enough to get the mill in complete adjustment so that it was not known what tin recovery could be made. The tailings carry 10 oz. silver showing that there has been but little or no concentration of it. Cyanidation of the tailings to recover the silver is being considered.

In addition to the equipment described, there is a roasting furnace and drier. It is found that the pyrite in the ore goes mainly into the fine-grained *barilla,* or concentrates, which carries less tin consequently than the coarse. The second layer in the kieve contains much pyrite and will be roasted. There is some barite in the *barilla,* and this mineral has been seen in small amount in the Misericordia ore. No antimony minerals have been recognized, but occasionally there is a little galena.

The mill is one of the most modern and best constructed in Bolivia, and the results of this attempt at mining low-grade tin ore in that country will be awaited with much interest and will doubtless exert a considerable influence on the development of the tin-mining industry of Bolivia.

The Patent Situation in Flotation

Following up the recent Supreme Court decision in favor of Minerals Separation, with which all operators are undoubtedly familiar at this time, the attorneys for that company have sent out a letter to all who are using flotation without license from Minerals Separation, notifying them of the Supreme Court's decision, inclosing a copy of the opinion and order of the court, and asking for a settlement for the infringement. Minerals Separation proposes to grant licenses on an equitable basis after payment for the process, as already used, has been made. A blank containing a number of questions, the replies to which are to be filled out and sent to the company, is included. Among the questions of technical interest are those which ask for the present and expected daily tonnage, general character of the ore treated, a note of the principal sulphide materials and of the principal gangue materials, the type of the milling plant and whether the flotation process is at present in use or has been used either experimentally or otherwise. The questionnaire also asks for a note of what proportion of total recovery is due to flotation, what number of tons is treated daily by flotation, and what number of tons total has been treated by flotation up to date. It also includes questions as to the type and manufacture of flotation apparatus used in the mill and suggests that a complete statement of flotation tests already made be given.

In general, Minerals Separation, according to the statement of its officials, desire first to clean up all questions of previous infringement and then license all users of the process on an equitable basis. The company intends, according to its statement, to use the fairest possible methods with the users of the process and has no idea of instituting vindictive methods with anyone who has used flotation without paying royalties for it. It is stated that an equitable and fair arrangement will be made with anyone who desires to use the process and that all arrangements will be made in a business way.

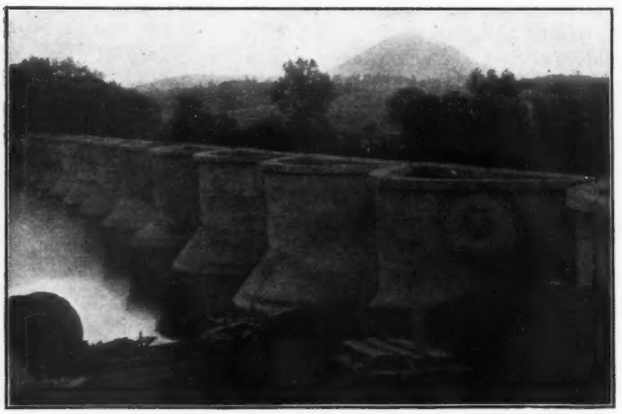
Hercules Powder Co.'s Potash Plant at San Diego, Calif., began the production of potash from kelp in June, 1916, but owing to the insufficiency of the kelp harvest, it has utilized only about 1000 tons of wet kelp per day. It was designed, however, to handle 1500 to 2000 tons per day, but so much less kelp was found than was indicated in the preliminary surveys that the company has been forced to secure its raw material at much greater distances than was at first anticipated, reducing the amount that can be delivered to the plant daily with the established marine equipment. The company's experience has indicated that from the California kelp beds from the Mexican line to Point Concepcion, which are practically the only beds that can be harvested throughout any large part of the year, there will actually be obtained during any one year approximately 22,000 tons of potash, as against the official estimate of 696,000 tons per annum available from the same beds. The company's reduction plant was designed to secure not only the potash content, but the fermentable content, and all other byproducts, recovery of which the market conditions may favor.

Two Eastwood-Dam Installations in California

By John S. Eastwood*

During the spring and summer of 1916 a dam was built for the Argonaut Mining Co.,[1] Jackson, Calif., for the purpose of storing the tailings from the new quartz mill which was being erected. This dam is one of the type, of which there are now a number in California, known as the Eastwood multiple-arched dam, in which the deck, or water face, consists of a series of arches supported by corresponding buttresses placed to take the loading at the spring lines of the arches.

This Argonaut dam is 50 ft. at its highest point at present, but will eventually be increased to 80 ft. in height. It is 450 ft. long on the crest and has 14 arches of 32-ft. span each, and 15 buttresses. It was designed on the assumption that the tailings from the quartz mill are the equivalent of a liquid having a weight of 75 lb. per cu.ft. In practice, however, there can never be a pressure of more than the hydrostatic pressure due to clear water, for the reason that as soon as the liquid reaches a weight of 75 lb. or more, it also becomes a viscuous mass that will



THE COMPLETED EASTWOOD DAM AT KENNEDY

assume an angle of repose that will reduce the pressure in a horizontal direction as its angle of repose increases.

The storage of the tailings from the quartz mills on the Mother Lode was started in compliance with an agreement with the farmers owning riparian lands on the streams below, which lands were claimed to have been injured by the overflow of sand on the bottoms along the streams; but after it was begun, it was found that these tailings, that have been wasted heretofore in the streams, have a content that with the aging of the tailings can be recovered at a profit by the flotation processes.

This process will make it a part of the regular operation to store the tailings for future treatment. This type of dam is the best that could possibly be devised for this purpose, as it combines the factors of great strength and permanency, economy in cost of construction and is the cheapest possible method of closing any opening (cheaper than earth-fill) and has greater strength than a solid masonry structure. In building these dams for débris storage, it is not essential that the cutoff wall at the front be made absolutely water-tight, but it must have a good and firm bearing on bedrock although a great part of the water carrying the tailings may be allowed to seep through.

The only practical difference made is that if the basin is small, there will possibly be a greater storage if the water is so far restrained as to permit the storage reservoir to fill and the water to spill over the spillways, owing to the greater angle of repose the fines will take in still water; but if the point of discharge into the reservoir is a considerable distance from the dam, it will be better if most of the water filters under the dam, as it will then be clear and not carry tailings over the spillway.

The storage capacity at the Argonaut dam is quite large in comparison with the cost of the dam. It stretches across a wide-bottomed ravine with a greenstone bedrock, which crops out in places to the surface, but in order to get a firm foundation, the excavation was carried to an average depth of about 6 ft. into this bedrock, requiring the removal of 1167 cu.yd. of earth and rock. The total number of cubic yards of concrete in the structure is 123, the total contract cost, $19,063 and the total over-all cost, $21,680. Work was begun on the structure on the first of March and completed in July, 1916.

Completion of the Kennedy Dam

The first installation of the multiple-arched type of dam was made by the Kennedy Mining and Milling Co., of Jackson, Calif., for whom a base 30 ft. high above ground was built for débris storage by the Eastwood Construction Co. in 1914, the capacity of which was fully occupied by July, 1916, when work was started to complete this structure to its final height of 50 ft. The base was completed in December, 1914, and was put in service at once, the water and débris being raised to within one foot of the top of the dam, the excess water flowing through a small spillway at this level. The extension consists of an addition to the rear of each of the buttresses of the base structure; raising these to a height of 50 ft.; adding the required buttresses at the ends; and raising the arched water face to the final height.

In adding the extension, the upper 12 ft. was carried up as a vertical head and the top finished with a cope along the entire length of the arches. Additional strut-tie beams were placed and the top beam built to a width of 4 ft. to serve as a footwalk as well.

This structure stands on the slate bedrock, which is nearly on edge, the strata running across the line of the dam. This made it necessary to place the toe of the dam firmly into the bedrock in order to prevent too much seepage under it. Quite a lot of the water seeps through over a well-distributed area, so that it comes through absolutely clear. In addition to the 20 ft. of dam now placed, a further extension of 4 ft. is provided for to be placed on the top of the arches when the present capacity has been reached.

The structure is provided with a spillway at the end to allow the excess water to flow over the dam. The rainwater is diverted around the top of the basin and is discharged below the dam so that only the mine-tailings water is to be taken care of through the spillway, excepting the rainfall on the area of the basin. This dam has a maximum height from foundations of 64 ft., is 690 ft. long on the crest and consists of 17 arches and buttresses, the buttresses being spaced 40 ft. apart. The base required 1233 cu.yd. of concrete and the extension

*Hearst Building, San Francisco, Calif.

[1]Described by Lewis H. Eddy, "The Argonaut Mine, California," "Eng. and Min. Journ.," Aug. 5, 1916.

1660 cu.yd., making a total of 2893 cu.yd. in the completed structure.

The capacity of the basin up to the top of the new dam is 15,804,164 cu.ft., though on account of the angle of repose of the coarser sands the storage capacity is nearly half again as much.

Work on the construction was begun on July 1 and was completed Nov. 1, 1916. The cost of the 30-ft. base was $25,658 and of the extension $26,367, making a total cost of $52,025. The cost per short ton stored is about 4.1c. which is small considering the possible returns from re-treatment.

Outfitting for Prospecting Trip in Nicaragua

By George F. Bridger*

The Atlantic Coast country of Nicaragua is a promising field for prospectors with some capital or representing small exploration companies. The mining code is liberal, and mine owners are given favorable concessions as regards mineral claims, surface rights, timber, water power, importation of mining machinery and prospecting outfits free of duty, etc. Foreigners are encouraged to engage in mining, and everything possible is done to foster gold production as the 3% export tax on gold is one of the country's sources of income.

Two months' stay on the Caribbean coast and in the jungle enabled me to gather some information which, while not purely technical, will perhaps be useful to engineers and prospectors who may visit the country.

Desultory placer washing is done by the natives, who also work the *hilos,* or stringers, carrying coarse free gold. Colors can be found in any of the creeks, but to find virgin ground one must go to the backwoods. A look at the country convinces one that there are good but not unsurmountable reasons why the gold resources have not been entirely exploited. In the past, surface working of the oxidized ores only has been done, and a milling plant consisting of a Huntington mill with amalgamating plates was used, with consequent high gold losses in the tailings, avoidable in the cyanide plant of today.

For a trip to Nicaragua one should outfit in the United States, as Nicaraguan prices are high and the quality of goods poor. No heavy clothes need be taken. For the towns Palm Beach suits or white duck, B. V. D. underwear, negligeé shirts, white socks, white shoes and a straw hat. A strong umbrella is useful during the intermittent showers and as a sunshade. For the "bush," light-weight khaki is recommended, a broad-brimmed hat and two pairs of high boots. Boots should be well viscolized, as one is always walking in water or mud.

While camping out, a folding cot is needed with an attachable framework for the indispensable mosquito bar. A light blanket, comfort, feather pillow, air mattress and bed linen should be bundled in the usual cowboy tarpaulin. The tarpaulin can be stretched over the cot as a rain shed.

A trunk should not be taken unless it is airtight. The great humidity causes the contents of an ordinary trunk to become covered with mold, and cockroaches will find their way into ordinary baggage. The natives make an excellent waterproof bag of strong cloth treated with crude rubber. These bags can be used inside of canvas dunnage bags, which may be tied to the canoe and a spill then means no loss or wet clothes. Inner bags of oiled silk would answer the same purpose and would not be harmed by salt water.

Supplies should be ordered packed for a tropical climate, and goods subject to harm by dampness should be put up in glass or tight tins. Custom duties are charged on the gross weight of the package. Failure to declare goods is punished by an increase of 100% in the duties. Rifles and shot-guns are taxed, and a permit must be secured from the government to take them out of the customhouse. A revolver and cartridges can be taken in on the person. Machinery shipped should be well painted to resist oxidation, and boilers, stacks, etc., should be heavily coated with tar.

There are few roads and trails in the coast country, and these are passible only in dry spells when the creek fords are shallow; at these times some packing can be done on bulls. The real highways of the country are the numerous rivers and their tributaries. Gasoline schooners carry passengers and freight from the port of entry, Bluefields, to the rivers. The back country is reached in *pitpans*—a cross between a dugout and a canoe—which are paddled or poled by Indians.

Traveling on the small streams at high water is rendered difficult by snags and the lack of headroom beneath the arching bamboo, and after a storm the fallen bamboo keeps a macheteman busy cutting a way. Careful outfitting, a knowledge of the seasons, money and considerable grit are needed to get over the country after leaving the beaten paths. The dry season favorable for prospecting is during February, March, April and May.

The Indian boatmen are paid 70c. per day and rations. Fresh meat soon spoils, so the ration for one Indian per day is: Flour, 1 lb.; beans, ½ lb.; rice, 6 oz.; coffee, ¾ oz.; sugar, 2 oz.; lard, 2 oz.; salt, 2 oz.; a little baking powder and some matches.

Plenty of fish can be taken from the streams, and the jungle teems with game, large and small. The hunting should be done by the blacks, however, as ticks make life miserable for the white man. The Indians make an infusion of tobacco leaves and water for washing the body after exposure to the ticks.

The Misskito Indians furnish the common labor; they are paid 60c. per day. West Indian negroes are the mechanics at $1.20; Spanish-speaking Nicaraguans from the interior are the miners at $1.20 per day. Board is given in addition to the wage scale.

The most interesting question to the white man is that of health. Until acclimated one should avoid heavy work during the heat of the day and never work until exhausted. At the end of the day one is usually wet with rainwater or with sweat and should always change into dry clothes. At the modern mines the members of the staff live in screened houses, sleep under mosquito netting, drink boiled, condensed or rain water. By doing this and keeping the bowels open the white men avoid the malaria.

The prospector should take one of the standard tropical medicine chests or at least a supply of quinine, cathartic pills, calomel and epsom salts. A fountain syringe, to administer enemas, and a first-aid outfit should be included.

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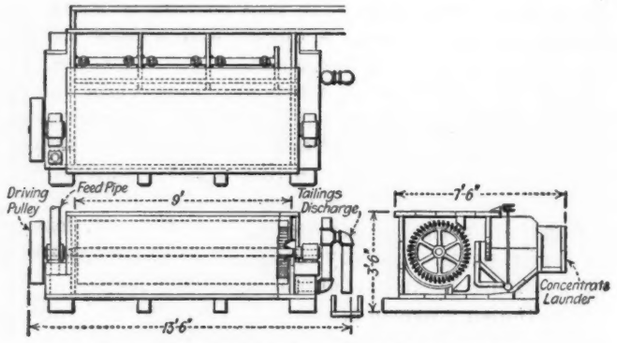
The Rork-Sandberg Flotation Machine

By George C. Westby*

One of the advantages in the application of flotation methods of concentration is the simplicity of the apparatus required. The pneumatic flotation devices, however, seem to have approached most closely the simplest mechanical terms. The Callow and Gahl machines are types which are notable both for effectiveness and lack of intricate mechanism, their operation depending only on the introduction of minutely subdivided volumes of air through porous materials into emulsified pulp. This type of apparatus calls for some form of blower as part of the system.

The Rork-Sandberg machine[1] is a pneumatic device which does not require an extraneous blower or compressor plant and has the advantages of the Janney type of pneumatic agitators. It is the prototype of all machines with a horizontal shaft carrying a partly immersed drum with fan blades distributed around the periphery.

The machine consists of a wooden casing, or chamber, fitted inside with baffles and diversion plates, a form of



RORK-SANDBERG FLOTATION MACHINE

spitzkasten, a steel shaft with cast-iron spiders carrying fan blades which are keyed or bolted to the periphery of the spiders to form a drum, and means for regulating the flow of pulp from the spitzkasten to the drum section of the chamber. The machine is constructed so that the shaft is sustained and rotates in bearings supported outside of the casing. A variable-speed motor belted to a pulley attached to the drum shaft operates the mechanism. Ordinarily, in practice the drum rotates between 180 and 200 r.p.m. A feed pipe at the pulley end of the machine receives the pulp charge, and a siphon at the other end discharges the tailings to waste.

In operation the drum, rotating in the direction indicated by the arrow in the accompanying sketch, beats up the pulp as it emerges into the chamber from the feed pipe and progresses in its spiral course to the discharge. At the same time air is drawn into the apparatus from the ends through annular openings about the shaft. The air is forced by the fan-like action of the blades of the drum into the pulp through slits between the fan blades. This action results in the formation of sulphide carrying froth from the emulsified pulp. The mixed froth and pulp is forced over the lip of a vertical partition into the spitzkasten section of the apparatus.

The froth discharges over the lip of the spitzkasten into the concentrate launder, while the residual pulp falls to the bottom of the section and passes back into the drum section of the apparatus for re-treatment or cleaning.

If the oil is charged into the pulp mixture passing to the tube mill or other form of pulverizer, no other preliminary treatment is necessary, and the undersize discharge of the grinder may be passed directly into the feed pipe of the Rork-Sandberg machine.

It is obvious that a machine unit of this kind combines the separate functions of a rougher and cleaner. It is plain also that the cell might be made of any length called for by any special kind of work required of it and made adaptable to the demands of differential flotation. The larger unit, whose dimensions are shown in the sketch, is designed to treat between 35 and 40 tons of 80-mesh material per 24 hr. The power required to operate would be about 5 hp.

The fan blades are made of hardwood and experience has shown that the machine may operate continuously eight or nine months before replacement of the worn blades is necessary. Repair is made easy by the provision of a hinged top to the casing, which gives convenient access to all parts of the interior of the casing.

The main advantageous features claimed for the machine are: Mechanical simplicity, accessibility, combined rougher and cleaner, a machine combining advantages of both pneumatic and agitation flotation machines and a low first cost. In addition it is a pneumatically operated flotation machine requiring no separate blower. It makes a moderately stiff froth, and good concentration is performed with the oils suited to the ore. The machine is installed in several mills, among which are those of Burro Mountain, at Tyrone, N. M.; the Detroit Copper Co., Morenci, Ariz.; the Old Dominion and the Shannon Copper Co.

*Metallurgical engineer, Ludwig, Nev.

[1]Patent No. 1,136,485; other patents applied for.

Assessment Work under Mining Location

By Arthur L. H. Street*

Section 2324 of the United States Revised Statutes provides that until patent is issued on a mining location not less than $100 worth of labor shall be performed or improvements made during each year, and that unless this is done, the claim shall be open to relocation the same as if no location of the same had ever been made, "provided that the original locators, their heirs, assigns or legal representatives have not resumed work upon the claim after failure and before such location."

Applying this provision in the recent case of Plough vs. Nelson, 161 Pacific Reporter, 1134, the Utah Supreme Court holds that forfeiture of an original location is prevented, and that no rights are acquired by another's relocation, where the original locator went on the claim the last day of the year, did part of the required work and remained there and completed it after the commencement of the next year, although another person made a relocation on the claim on the first day of such succeeding year, before the original locator completed his work. The Utah Supreme Court cites numerous decisions of the Federal courts supporting the rule that commencement of assessment work in a given year will avoid a forfeiture if prosecuted continuously.

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American Institute of Mining Engineers

SYNOPSIS—A review of the annual New York meeting of the Institute, which included a number of interesting technical sessions and a varied program of social activity. The vote for president resulted in the selection of Philip N. Moore of St. Louis. The presence of Herbert C. Hoover, both at the Reunion Smoker and at the Banquet, lent a great amount of interest to these occasions.

The 114th meeting of the American Institute of Mining Engineers closed on Thursday afternoon, Feb. 22, after an all-day excursion by the members to the United States Military Academy, at West Point, N. Y. The first session of the meeting took place at 10:30 a.m. on Monday, Feb. 19, after which there were sessions, both of technical and social interest, morning, afternoon and evening. The meeting was attended by more than 500 mining engineers, including many of the most prominent of this country. There was also a large attendance of Canadian engineers.

The Opening Sessions

On the first day of the meeting members were registering at the headquarters of the Society during the whole day, planning the technical sessions they desired to attend, and selecting those social activities most attractive to them. At 10 o'clock there were sessions on geology and on metallography, William Kelly presiding at the first and Albert Sauveur at the second. At the session on geology, the indebtedness of the United States to Brazil for its supply of manganese ore since the outbreak of the European War was pointed out by Dr. Joseph E. Singewald, Jr., and Dr. Benjamin Le Roy Miller. Manganese is one of the few important metals that is not produced in the United States in quantities commensurate with the needs, and that there is now being imported about 300,000 tons of ore annually. In a year's time Brazil's portion of the manganese importation jumped from two-fifths to nine-tenths of the total. Prior to the war, India and Russia supplied the greatest part of the American consumption.

Other papers dealing with geology included one by Max Roesler on the "Geology of the Iron Ore Deposits of the Firmeza District, Oriente Province, Cuba," one by J. F. Wolff on the "Recent Geological Development of the Mesabi Iron Range, Minn.," one by M. H. Loveman on the "Geology of the Bawdin Mine, Burma, Asia," and one by Frank C. Schrader on the "Geology and Ore Deposits of Mohave County, Ariz."

The session on metallography included papers by Zay Jeffries on "Grain Growth Phenomena in Metals," one by Henry M. Howe on "Grain Growth," and another on "Recrystallization after Plastic Deformation" by the same author, another paper by Zay Jeffries on "Tungsten and Molybdenum Equilibrium Diagram and System of Crystallization," and a paper by Frank A. Fahrenwald on "The System Tungsten-Molybdenum."

The ladies' committee, in charge of Mrs. H. W. Harding, chairman, and Mrs. Bradley Stoughton, secretary, provided an interesting visit to the art galleries of H. C. Frick, for the ladies attending the Institute meeting, and at 4:35 p.m. gave a tea at the Waldorf-Astoria, at which there was an interesting exhibition of ice skating.

Technical sessions were held on Monday afternoon, one on petroleum and gas, presided over by Mark L. Requa, and another on milling and smelting, presided over by Sidney J. Jennings. All of these meetings were well attended and proved highly interesting, both technically and socially.

The smoker reunion held in the Engineering Societies Building on Monday evening was on novel lines and was the greatest success of any of the Institute's smokers. The two lecture halls were opened into each other and filled with small round tables and chairs, and on the tables, arranged according to proper groupings, were pennants of the various colleges represented by members who expected to be present. Beer, pretzels and interestingly prepared souvenir packages of smokes were provided in abundance. The meeting opened with all standing and singing "America" accompanied by the piano and a pianist, who, unlike the average, knew when and what to play and when not to play at all. D. H. Browne announced that one of the important members had recently left this country to return to the land of his birth to engage in important metallurgical work; that when in this country he was a naturalized citizen, and that he felt it proper to call upon E. P. Mathewson to tell the members where he stood. Mr. Mathewson promptly took the rostrum and dispelled any doubt on the subject by beginning "Fellow Citizens." He said that when he went to Montreal there was some doubt in his mind as to what was to be done in the matter and inquiry resulted in his being passed from one bureau to another, and they were not at all backward in telling him they did not know who he was or anything about him, and finally he discovered that if he takes the step it will require five years to regain his citizenship in the country of his birth and "So," he finished, "I am still with you."

Philip N. Moore was called upon and said that his position (as presidential candidate) was an anomalous one at present and it was like a man who was unable to tell whether he was standing on solid bottom or quicksand. He was followed by Sidney J. Jennings who told one of his interesting and inimitable stories about a Frenchman in South Africa who came down there to show them how to do their blasting underground with water pressure instead of explosives.

Following this, D. H. Browne read one of his unpublished and hitherto unread stories written on Irish child life, which was a picture of his life forty-five years ago, when he was a small boy in Ireland. It was filled with inimitable charm and novelty, and was very well received. Dr. R. W. Raymond was then introduced.

Dr. Raymond's Introduction of Hoover

Dr. Raymond, in his usual felicitous style, told about Hoover, his early life, his translation of Agricola and his work with the American tourists at the outbreak of the war, and subsequently with the Belgian Relief Commission. The latter two, he said, were characteristically mining engineering jobs. The work confronting this original committee was so tremendous that the committee almost automatically divided itself into three 8-hr. shifts and the work went on without cessation 24 hr. a day. In one instance the English authorities announced that, since

everybody was overworked, everything would stop for 48 hr., no trains would be received, etc., and everybody could have a rest. The American Committee announced that it did not need any rest, that it was running along smoothly, and would continue operations. At two o'clock in the morning of the next day, a train unexpectedly arrived with 2000 hysterical schoolma'ams, young girls unattended, and distressed women. These were met by the American mining engineers and their wives, and in every case were properly cared for. After many interesting personal remarks about Hoover, who is rapidly becoming the pride of the whole world, Dr. Raymond said: "It is not necessary to consult "Who's Who" to find out "Who's Hoover" and after announcing that the Belgian Kiddies, Ltd., had now raised $75,000 to aid him in his work he introduced H. C. Hoover.

Hoover's reception was a touching one, and he was visibly affected. After waiting for long and renewed applause, he began by giving the credit which Dr. Raymond had bestowed on him for the translation of Agricola wholly to his wife, and the work of his committee wholly to his associates, of which he said he was chairman simply by accident. He is so loyal to those who are working with him in this great work that it seems impossible to make him take any credit for the wonderful work he has accomplished. He then began by telling some very interesting and amusing episodes which occurred during the time he and his committee were getting 100,000 hysterical tourists back to this country at the outbreak of the war. He said the committee provided $300,000 which they raised themselves to cash checks, letters of credit, express orders, etc., for these tourists, which of course were uncashable anywhere else at that time. The committee divided all of the applicants into three classes: Good, bad and indifferent; to the good they gave money on their own personal checks without any security or question and, be it said to the credit of the judgment and perception of the American mining engineers, of that $300,000 all has been returned except $250 which Hoover is convinced remains unpaid solely on account of a loss of address. Of the indifferent ones, the government put up the money and has been trying ever since to collect. Those judged bad were simply sent into one department, were handed transportation home, and bundled off accordingly. One of the most amusing incidents was when a cowboy, a real live, Western cowboy with nine perfectly good Indians dressed in feathers from top to toe, walked into the office and wanted to get back home. They had been running a Wild West show on the continent when the war broke out and were possessed of several ponies, a camel, and an ourang-outang and two lions. Hard times struck them and they killed the ourang-outang, who was objectionable anyway, and fed him to the lions, which were worth $1000. Then they fed the camel and one after another of the ponies to the lions and, being unable to sell the lions to the zoo at Cracow, because the Russians were closing in on it so rapidly, they finally ducked out for Hamburg one night and left the lions in the hotel yard. At Hamburg they picked up a typical American boy who had $12 and who was trying to get back to America alone whence he had been sent.

The cowboy announced that he wanted to get his troupe back to America; that the most valuable things they had were their paraphernalia and feathers, and not being able to carry any baggage they were wearing their full dress uniforms. He announced that he did not want to borrow any money; he did not want any Government money, but he had a farm in North Dakota and he wanted to mortgage it for enough to get home on and more particularly the first thing he wanted to do was to pay back to the boy his $12. After the financial arrangements were made, one of the ladies offered to take care of the boy until he could be properly delivered to his family, but the boy said that White Cloud was a friend of his and that never having had an opportunity before to live with an Indian, he thought he would stay with the outfit. Hoover turned from this diverting experience to a serious one and touched very briefly, saying that evening was not a time for going deeply into serious things, on the Belgian Relief and was again applauded.

Before the speeches, which were of an entirely new variety in that they were all short and pithy, several interesting reels of films, taken by the French Government and owned by the French propaganda in New York, were exhibited showing the manufacture of the larger guns in France and then many scenes in the trenches and battlefields, with particular reference, of course, to the artillery action. During the periods between speeches, there were songs and music.

After Hoover had finished, Chairman Brown announced that after listening to Hoover anything that anyone else might say would be an anti-climax and that the meeting stood adjourned. It was nearly three quarters of an hour later, however, when the last guest left the hall, the period having been spent in chatting with Hoover and among themselves.

The Election of Officers

At the business meeting held on Tuesday morning, Feb. 20, beside the regular reports of the various committees, and the secretary and treasurer, the two most important things were the announcement by the tellers of the balloting for the president and the result of the "simp" spelling crusade. Philip M. Moore was declared elected President, having received 1205 votes, Sidney J. Jennings having received 1010 votes.

All three of the questions as to the adoption of simplified spelling, which were submitted to a referendum of the members were carried heavily in the affirmative, besides which 346 unmarked ballots were sent in to be used by the directors at their discretion. Therefore, unless the directors fly in the face of Providence, simplified spelling for the Institute may be considered a *fait accompli*. Contributors (to the *Transactions*) need have no further worry about deficiencies in spelling, since "simp" spelling will cover a multitude of sins.

At 11 a.m. there was a technical session dealing with nonmetallic minerals presided over by Prof. Heinrich Ries, of Cornell University. The papers included one on "A Study of the Silica Refractories," by J. Spotts McDowell; one on "The Genesis of Asbestos and Asbestiform Minerals," by Stephen Taber; and one on "The Conservation of Phosphate Rock of the United States," by W. C. Phalen. The ladies held an open forum on current events of the day at 10:30 a.m. At this meeting subjects of general interest were discussed and arrangements were made by the ladies for the carrying out of the remaining parts of their program. In the afternoon they visited the galleries of Senator W. A. Clark, where they were entertained by an organ recital. The visit to

Senator Clark's galleries has been a feature of interest for attendants at the New York meetings of the Institute for several years, and has always been one that was highly appreciated. This year the attendance was good, and all of the ladies, particularly, were much pleased and interested in the visit.

The sessions of Tuesday afternoon were of great interest, the one on blast-furnace practice bringing forth four papers, one on "Dry-Hot vs. Cold-Wet Blast-Furnace Gas," by Linn Bradley, H. D. Egbert and W. W. Strong; "Some Suggestions Regarding Construction of Hot-Blast Stoves," by the same authors, "Calculations with Reference to the Use of Carbon in Modern American Blast Furnaces," by H. P. Howland, and "Potash as a By-product from the Blast Furnace," by R. J. Wysor. The session on flotation brought forth but one contributed paper, that by J. M. Callow, on "Notes on Flotation, 1916." The paper was read by H. A. Megraw, in abstract, special attention being paid to that portion dealing with the sulphide filming plant at the Magma mill. B. A. Robinson, assistant secretary of the Institute, read a discussion of the paper by Dr. Rudolph Gahl, who sent his discussion by telegraph. Dr. Gahl pointed out his differences in opinion from Mr. Callow, particularly in comparisons of the Callow and Inspiration flotation machines.

G. D. Van Arsdale remarked that operators were beginning to discover the theory that the applications of flotation depended upon the character of the gangue as well as the character of the mineral. E. E. Free spoke upon the theory of the process, pointing out the possible effect of adsorbed films upon mineral and gangue particles, and suggested that in this detail might be discovered the means of altering flotation effects.

Professor J. W. Bell, of McGill University, spoke of the impossibility of getting good flotation results in many cases without an acid solution. H. W. Dubois touched upon the legal status of the process, as also did the chairman.

On Tuesday evening, the annual banquet of the Institute took place at the Hotel Astor. At 6:30 p.m., a reception was given to the retiring president, Dr. L. D. Ricketts, and Mrs. Ricketts, and to Mr. and Mrs. Herbert C. Hoover, guests of honor, in the reception room. Following the reception, the annual banquet was served.

Afterward, Dr. Ricketts, the retiring president, made a short address outlining the work done by the Institute during the year of his incumbency, and finally introduced the president-elect, Philip N. Moore, of St. Louis. Mr. Moore promised his most earnest service to the Institute and pledged himself to do all in his power to accomplish its objects.

After Mr. Moore had finished, Dr. Ricketts introduced Herbert C. Hoover. A tremendous ovation was given to Mr. Hoover, who was unable to speak for some time, owing to the cheering and, after that, to his own emotions. Mr. Hoover spoke only a short time, the burden of his remarks being an effort to transfer attention from himself to his associates on the Committee for the Relief of Belgium.

On Wednesday, Feb. 21, a technical session on the manufacture of iron and steel was held at 10 o'clock in the morning, Henry B. Hibbard, presiding. The papers presented were: "The Seasoning of Castings," by Richard Moldenke; "Significance of Manganese in American Steel Metallurgy," F. H. Willcox; "Roll Scale as a Factor in the Bessemer Process," by A. Patton and F. N. Speller; "Temperature Measurements in Bessemer and Openhearth Practice," by George K. Burgess; and "The Manufacture of Weldless Steel Tires for Locomotives and Car Wheels," by Guilliaem Aertsen.

At 12:30 p.m. the usual luncheon was served and this luncheon was particularly interesting since it was attended by a large number of members of the Naval Consulting Board. The interest of this body had been attracted by a paper on "Erosion of Guns—the Hardening of the Surface," by Henry Fay. Some members of the Consulting Board expressed a desire to hear this paper, so an invitation was extended by the Institute to the whole body, and many of them attended.

The technical sessions of the afternoon were one on the Metallography and Heat Treatment of Steel, Albert Sauveur presiding, this being the meeting of interest to the Naval Consulting Board, and one on Mining Methods, R. M. Catlin, presiding. At the first-named session, the paper on the "Erosion of Guns" was presented in addition to one on "Notes on the Heat Treatment of High-Speed Steel Tools," by A. E. Bellis and T. W. Hardy; one on the "Effect of Time in Reheating Hardened Steel Below the Critical Range," by C. R. Hayward and S. S. Raymond; one on "The Effect of Sulphur on Low-Carbon Steel," by C. R. Hayward, and one on "A Method for Distinguishing Sulphide from Oxide in the Metallography of Steel," by George F. Comstock. The session on Mining Methods included a paper on "Anthracite Stripping," by J. B. Warriner; one on "Portable Miners' Lamps," by E. M. Chance; one on "Shot Firing in Bituminous Mines," by M. D. Cooper; one on "The Pennsylvania Mine Fire, Butte, Mont.," by C. E. Nighman and R. S. Foster, and the reports of the secretary of the Committee on Safety and Sanitation.

On Wednesday afternoon there was a theater party for the ladies, who attended "The Yellow Jacket" at the Harris Theater. At 5 p.m. a party of ladies went to visit a moving-picture studio, where they were entertained by seeing the making of a "thriller."

Demonstration of Colored Moving Pictures

On Wednesday night Dr. Herbert T. Kalmus gave a lecture illustrated by experiments, showing the fundamental principles of the process and demonstrating its commercial adaptation to the production of photoplays in color. Special emphasis was laid on the fact that this process is not limited to the taking of scenery, portraits and other very slowly-moving objects, but is being commercially used for the production of actual photoplays.

The success depends upon the ordinary motion-picture principle, together with a second optical principle as follows: All colors and every shade thereof may be produced by the combination of three fundamental colors, the proper shade of red, green and blue, combining them in the proper proportions. Furthermore, a practical approximation to faithful colors may be obtained by substituting for the three above-mentioned colors a particular red and a particular green. That is, two fundamental colors.

The Technicolor process is free from "color fringes" and "color flicker." It is accomplished as follows: Instead of photographing 32 pictures per second one after another, 16 pairs of pictures are photographed. The easiest way to do this would be to have two lenses, and

to simultaneously photograph through these, one through the green screen and the other through the red screen. A moment of reflection, however, will show that this would not do, for such a pair of pictures are taken from different points of view. Consequently they are not identical and could never be brought into register

The Technicolor camera photographs two simultaneous pictures through the same lens; that is, from the same point of view; one through a green screen, and the other through a red screen. Pictures taken at the same time from the same point of view by the same lens must be identical in form and hence can be brought absolutely into register.

These are projected in pairs in register on the screen, and consequently there is no possibility of color fringes. Moreover, since these are projected in pairs in register, the actual color exists on the screen, so that there is no color mixing for the eye to do, that is, no color flicker. The general effect is a relatively peaceful picture, relatively free from eye fatigue.

On Thursday the party made an excursion to the Military Academy, West Point, leaving on a special train over the West Shore Railroad at 9 a.m. Arrival at West Point was at about 10:30 o'clock, and at 11:15 there was a riding drill and exhibition given by cadets at the Academy. The luncheon was served from about 1 to 2 p.m. in Cullum Memorial Hall. At 2 p.m. there was an address by Col. Biddle, commandant at the Post, on an interesting military subject. Then Dr. Raymond made an interesting address. Opportunity was given the members and guests to visit points of interest.

This meeting was largely attended and proved to be one of the best and most instructive meetings ever held in New York.

The *Daily Fume* made its appearance every day of the meeting and was even more cordially received than it was last year.

The Market for Explosives in Chile

Various methods are employed in handling the trade in explosives in Chile. One agency has for its manager in Antofagasta an American engineer, who travels frequently into the interior and sees personally the leading consumers in the interest of the explosives that he represents. He has arranged demonstrations and tests and in an intelligent way promotes interest in his product. Other sellers of explosives also have employees who devote their attention to technical features, so that the merits of the various brands are brought to the attenion of intending purchasers in effective ways. Imports of this class of goods in 1914 and 1915 by principal ports, according to Consul Thomas W. Voetter, in *Commerce Reports* of the Department of Commerce, Feb. 15, 1917, were:

VALUE OF EXPLOSIVES IMPORTED

Ports	1914	1915
Dynamite:		
Iquique	$59,523	$19,334
Tocopilla	21,815	7,700
Antofagasta	134,284	177,961
Taltal	17,164	6,267
Blasting caps:		
Iquique	9,211	3,507
Tocopilla	3,000	.....
Antofagasta	29,622	12,564
Taltal	3,870	.....
Fuse:		
Arica	146	86
Iquique	13,862	6,167
Tocopilla	3,264	2,856
Antofagasta	23,750	7,816
Taltal	5,471	2,630

The gunpowder used is manufactured locally, all the ingredients being produced in Chile. Sulphur is extensively mined in or near former volcanic craters. The other articles are not segregated in the lists of imports, and quantities or value cannot be ascertained. In the classification of dynamite as given are included all similar varieties of explosives, such as gelignite, etc.

The rates of duty levied by the tariff law of 1916, all specific, in United States currency per pound gross weight, are: Blasting powder, 1.66c.; caps, 6.62c.; fuse, 0.83.c.; dynamite, 1.32c.; batteries, 1.66c.

Few regulations govern the handling of explosives. In practice the restrictions are confined to unloading from the vessel at a distance from the usual place of anchorage in front of the city, landing at a separate cove, storage in magazines outside the city limits and transportation to railway loading places by roads distant from the centers of population. High explosives are transported in separate railway cars. When these precautions have been taken, the free sale of explosives is not restricted.

In the nitrate fields a powerful explosive which would shatter the *caliche,* or nitrate-bearing strata, is not desired, so a low grade of black powder is used. Dynamite is used more especially in the mines.

Purchases for nitrate *oficinas* are usually made through port agents, who are generally the leading general importers, although some of the nitrate companies have their own port offices.

Utah Copper Co.'s Tailings Pond

The area of ground owned by the Utah Copper Co. which will be used solely for impounding tailings embraces 6000 acres. It is bisected in an approximately east and west direction by the main-line tracks of the Western Pacific and Los Angeles & Salt Lake railroads, and in order to make use of it to the best advantage and in the most economical manner, it will be necessary to move these tracks to the north a distance varying between about 1 and 1½ mi. These track changes will extend from a point 7.75 mi. east of Garfield station to a point 1¼ mi. west of that station, making the total length of the change about 9 mi. The Bingham & Garfield Ry., which now connects with the Los Angeles & Salt Lake R.R. at a point about ¾ mi. east of Garfield station, will also have to construct additional trackage to make a connection with the new location of the latter road.

A levee will be constructed around this entire area, so that the tailings from the concentrating plants can be impounded and dewatered. The levee around the tailings pond will at first be built comparatively low, and it will be raised from time to time as operations require. The ultimate capacity of the pond is estimated at 500,000,000 tons, although it can easily be increased to a greater quantity than that if it should be found necessary, by simply building the levee higher. The area has a length east and west of about 4½ mi., and the natural drainage of the country will have to be diverted and taken care of through a drainage ditch which will be constructed along the entire north side of the pond. This ditch will be large enough to carry not only the drainage water in times of heavy rainfall, but also any surplus water from the tailings pond, and it will have a total length of approximately 6 mi.

Hand Stoking Soft-Coal Boilers

Owing to the greater quantity of soft coal than anthracite, most mine steam power plants are operated on soft coal. The proper design of the boiler setting to permit of the most perfect combustion is essential to economic operation, and the proper stoking of these furnaces is of utmost importance both from the standpoint of smoke reduction and fuel economy. Smoke is a most direct measure of imperfect combustion and consequently of low economy. Charles H. Bromley in *Power,* Jan. 9, 1917, gives data on proper design and operation that should prove interesting and profitable to the mine operator using hand-fired soft coal furnaces as his source of power. It is the duty of firemen to burn coal economically and with as little smoke as possible. In this article bituminous coal is considered exclusively, and the best methods of burning it in hand-fired horizontal tubular boilers as demonstrated under commercial conditions. However competent the man, smokeless and economical combustion is commercially impossible unless the furnace is suitable; that is, has volume, proper proportions and adjuncts. Without these essentials—namely, draft, temperature, time, and gas and air mixing provisions—good combustion cannot be had. A typical soft coal has the following principal constituents as received: Fixed carbon, 57.6%; volatile, 32.24%; ash, 7.32%; moisture, 2.84%. The coal is a solid. On being burned everything but the ash and what combustible remains in it is driven off as gas accompanied by a small quantity of fine solid particles. The volatile matter consists largely of oils which will distill off, some at temperatures a little below 300 deg. F., and others, the heavier ones, at 800 to 950 deg. F. Running normally, the furnace temperature will be about 1,800 to 2,500 deg. F. (hand-firing)—from six to eight times as high as needed to support distillation. After these oils vaporize and gasify, they must receive enough air for their combustion, must have sufficient temperature to carry on combustion and must be well mixed with the air for combustion. And all this should happen before the gases get into the boiler tubes; in fact, for best results the whole combination of events should be completed before the gases touch the heating

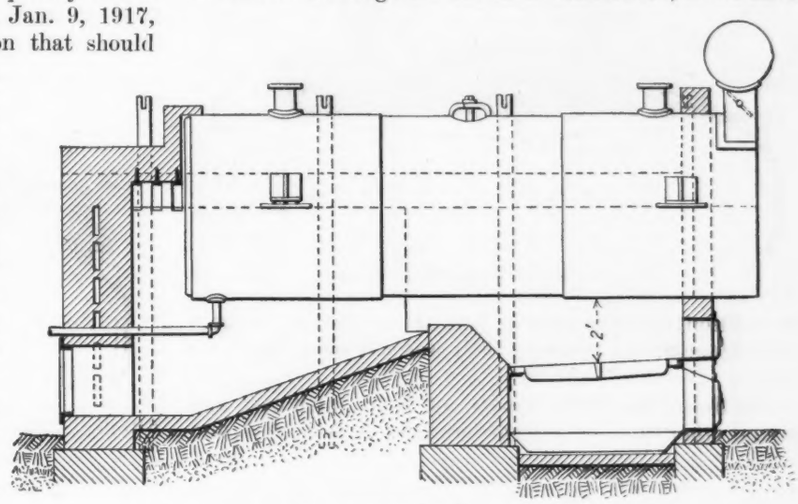


FIG. 1. THE OLD HARTFORD STANDARD SETTING

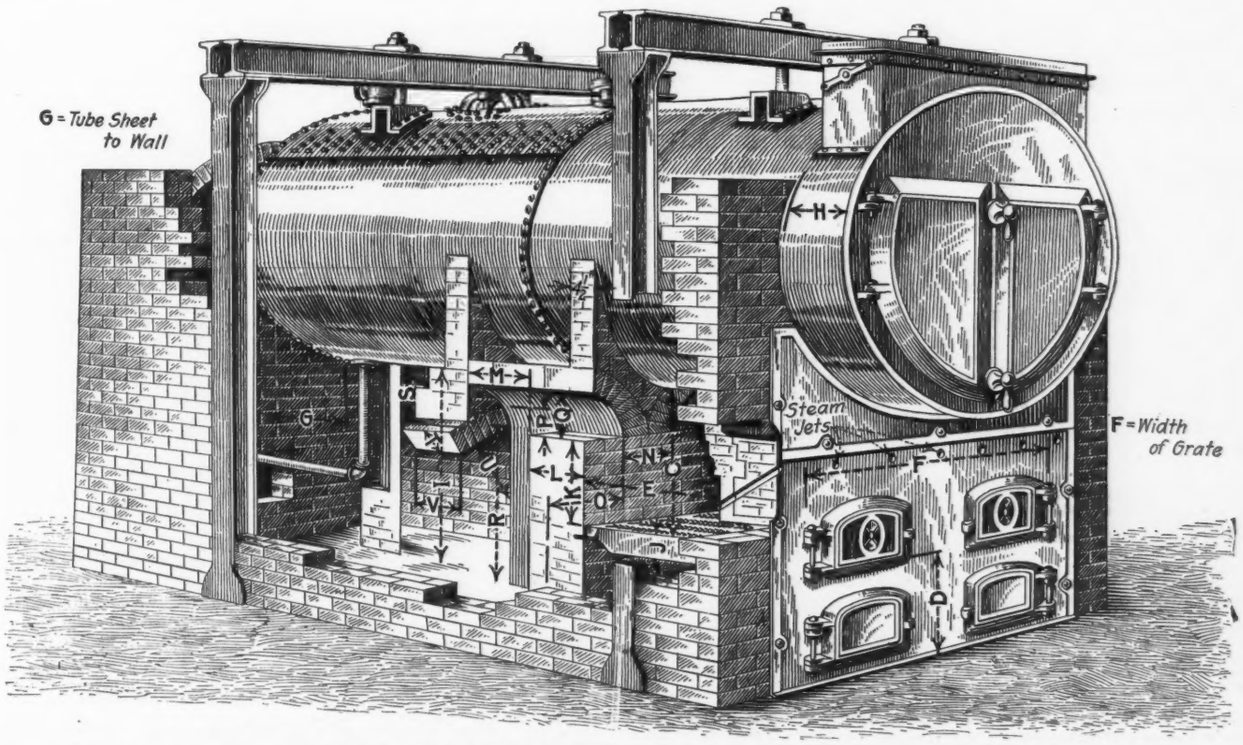


FIG. 2. IMPROVED TYPE OF SETTING RECOMMENDED FOR HORIZONTAL RETURN-TUBULAR BOILERS

surface at all—in less than a second, even with an uncommonly high setting. Is it to be wondered at, then, that this is impossible in the widely used Hartford standard setting, Fig. 1, where the boiler shell is but two feet above the grate?

In one investigation of a large number of boiler plants it was found that over 90% of the boilers were of

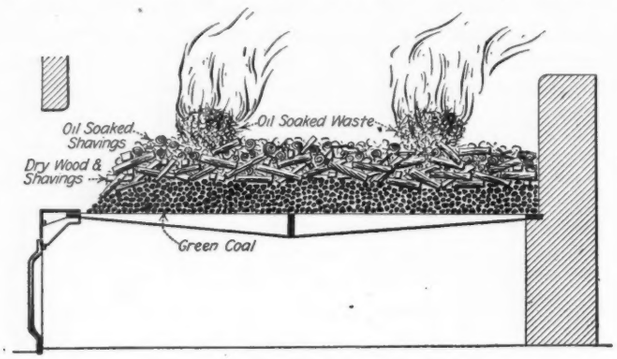


FIG. 3. STARTING THE FIRE

the horizontal return-tubular type having settings wherein the distance from grate to shell was not more than two feet.

The flush-front and the extension-front dutch oven and several other types of settings have been investigated, and

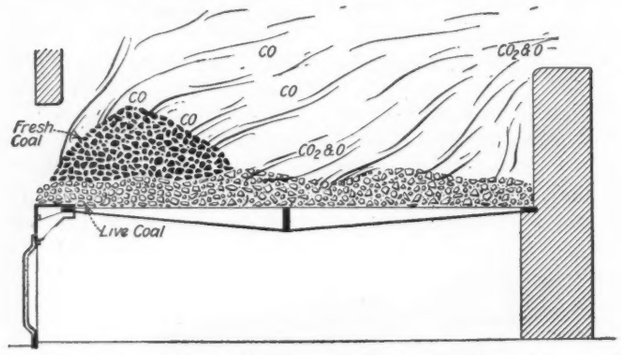


FIG. 4. COAL COKING AT THE DEADPLATE

that which gave the best results, smokelessness and economy considered, is shown in Fig. 2. This setting is recommended by nearly all smoke inspectors and is becoming standard in soft-coal burning districts. It represents the application of facts discovered and corroborated by thousands of tests and observations. The dimensions as given in the accompanying table referring to Fig. 2 are those used by the smoke inspection department of a large municipality. It is recommended that for all hand-fired furnaces using coal above 25% volatile the distance from shell to grate be not less than 4 ft. or the nearest approach to that height that commercial brick will give.

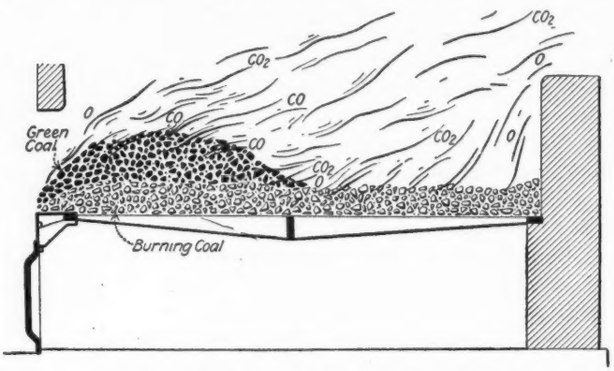


FIG. 5. COKING METHOD WITH FRESH COAL SPREAD OUT MORE THAN IN FIG. 4

To build a fire in a cold boiler without excessive smoke, is regarded as at least extremely doubtful by the average man. But it can be done. Here is a method applicable to stationary boilers, which gives good results.

The entire grate is covered with 3 in. of gas coal (assumably a coal containing from 32 to 38% volatile) spread evenly, and upon this is laid a layer of low-volatile coal (about 20%) thoroughly wet to a depth of 4 in. Dry wood shavings are then spread over the surface of the coal, after which an ordinary bucket of shavings soaked in crude oil is distributed on top of the dry shavings. A piece of oil-soaked waste is thrown into the middle of the grate to ignite the shav-

SPECIFICATIONS FOR IMPROVED SETTING HORIZONTAL TUBULAR BOILERS TO ACCOMPANY FIG. 2

Diameter shell	84 in.	84 in.	78 in.	78 in.	72 in.	72 in.	66 in.	66 in.	60 in.	60 in.	54 in.	54 in
Length shell	20 ft.	18 ft.	20 ft.	18 ft.	18 ft.	16 ft.	18 ft.	16 ft.	18 ft.	16 ft.	16 ft.	14 ft.
C	42 in.	42 in.	42 in.	42 in.	36 in.	36 in.	36 in.	36 in.	36 in.	36 in.	36 in.	36 in.
D	2 ft. 2 in.	2 ft. 2 in.	2 ft. 2 in.	2 ft. 2 in.	2 ft.	2 ft.	2 ft.	2 ft.	1 ft. 10 in.	1 ft. 10 in.	1 ft. 10 in.	1 ft. 10 in.
E	6 ft. 6 in.	6 ft.	6 ft. 6 in.	6 ft.	6 ft.	5 ft. 6 in.	5 ft. 6 in.	5 ft.	5 ft. 6 in.	5 ft.	4 ft. 6 in.	4 ft.
F	7 ft.	7 ft.	6 ft. 6 in.	6 ft. 6 in.	6 ft.	6 ft.	5 ft. 6 in.	5 ft. 6 in.	5 ft.	5 ft.	4 ft. 6 in.	4 ft. 6 in.
G	2 ft. 10 in.	2 ft. 10 in.	2 ft. 8 in.	2 ft. 8 in.	2 ft. 6 in.	2 ft. 6 in.	2 ft. 4 in.	2 ft. 4 in.	2 ft. 2 in.	2 ft. 2 in.	2 ft.	2 ft.
H	1 ft. 10 in.	1 ft. 10 in.	1 ft. 9 in.	1 ft. 9 in.	1 ft. 8 in.	1 ft. 8 in.	1 ft. 7 in.	1 ft. 7 in.	1 ft. 6 in.	1 ft. 6 in.	1 ft. 5 in.	1 ft. 5 in.
I	6 ft. 4 in.	5 ft. 10½ in.	6 ft. 5½ in.	6 ft.	5 ft. 11½ in.	5 ft. 6½ in.	5 ft. 7 in.	5 ft. 1½ in.	5 ft. 9 in.	5 ft. 4 in.	4 ft. 11 in.	4 ft. 8 in.
J	6½ in.	6 in.	6½ in.	6 in.	6 in.	5½ in.	5½ in.	5 in.	5½ in.	5 in.	4½ in.	4 in.
K	1 ft. 10½ in.	2 ft.	1 ft. 9½ in.	1 ft. 11 in.	1 ft. 6 in.	1 ft. 7 in.	1 ft. 7 in.	1 ft. 8 in.	1 ft. 5½ in.	1 ft. 6½ in.	1 ft. 7½ in.	1 ft. 6 in.
L	2 ft. 3 in.	2 ft. 3 in.	2 ft. 3 in.	2 ft. 3 in.	2 ft.	2 ft.	1 ft. 10½ in.	1 ft. 10½ in.	1 ft. 10½ in.	1 ft. 10½ in.	1 ft. 6 in.	1 ft. 6 in.
M	3 ft.	3 ft.	2 ft. 10 in.	2 ft. 10 in.	2 ft. 6 in.	2 ft. 6 in.	2 ft. 4 in.	2 ft. 4 in.	2 ft. 2 in.	2 ft. 2 in.	2 ft.	2 ft.
N	1 ft. 6 in.	1 ft. 6 in.	1 ft. 6 in.	1 ft. 6 in.	1 ft. 1½ in.	1 ft. 1½ in.	1 ft. 1½ in.	1 ft. 1½ in.	1 ft. 1½ in.	1 ft. 1½ in.	1 ft. 1½ in.	1 ft. 1½ in.
O	2 ft. 9 in.	2 ft. 9 in.	2 ft. 6 in.	2 ft. 6 in.	2 ft. 5½ in.	2 ft. 5½ in.	2 ft. 2½ in.	2 ft. 2½ in.	1 ft. 11½ in.	1 ft. 11½ in.	1 ft. 8½ in.	1 ft. 8½ in.
P	1 ft. 4 in.	1 ft. 2 in.	1 ft. 5½ in.	1 ft. 3½ in.	1 ft. 1 in.	1 ft. 1½ in.	1 ft. 1½ in.	1 in.	1 ft. 3 in.	1 ft. 1½ in.	1 ft. 1¼ in.	1 ft. 2½ in.
Q	2 ft. 5½ in.	2 ft. 3½ in.	2 ft. 5½ in.	2 ft. 3½ in.	2 ft. 2 in.	2 ft. ½ in.	2 ft. ½ in.	1 ft. 11 in.	2 ft. ½ in.	1 ft. 11 in.	1 ft. 8½ in.	1 ft. 9 in.
R	4 ft. 2 in.	3 ft. 10½ in.	4 ft. 2½ in.	3 ft. 11 in.	3 ft. 11½ in.	3 ft. 8 in.	3 ft. 8½ in.	3 ft. 4½ in.	3 ft. 9 in.	3 ft. 5½ in.	3 ft. 2 in.	2 ft. 10 in.
S	2 ft. 2 in.	2 ft.	2 ft. 5 in.	2 ft. 1 in.	2 ft.	1 ft. 10½ in.	1 ft. 10½ in.	1 ft. 9 in.	2 ft.	1 ft. 10½ in.	1 ft. 9 in.	1 ft. 10 in.
T	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.	9 in.
U	1 ft.	1 ft.	1 ft.	1 ft.	1 ft.	1 ft.	11 in.	11 in.	10 in.	10 in.	9 in.	9 in.
V	1 ft. 1½ in.	1 ft. 1½ in.	1 ft. 1½ in.	1 ft. 1½ in.	1 ft. 1¼ in.	1 ft. 1½ in.	1 ft. 1½ in.	1 ft. 1½ in.	1 ft. 1½ in.	1 ft. 1½ in.	1 ft. 1½ in.	1 ft. 1¼ in.
Number and size of tubes	92–4 in.	92–4 in.	88–4 in.	88–4 in.	70–4 in.	70–4 in.	54–4 in.	54–4 in.	46–4 in.	46–4 in.	36–4 in.	36–4 in.
Heating surface in tubes	1932.0	1738.8	1842.8	1658.5	1323.0	1176.0	1017.7	904.6	866.9	770.6	604.8	529.2
Heating surface in shell	219.9	197.9	204.2	183.8	169.6	150.7	155.5	138.2	141.3	125.6	113.1	99.0
Total heating surface tubes and shell, sq.ft	2151.9	1936.7	2047.0	1842.8	1492.6	1326.7	1173.2	1042.9	1008.2	896.2	717.9	628.2
Boiler horsepower	215	194	205	184	149	133	117	104	101	90	72	63
Square feet of grate surface	45.5	42.0	42.25	39.0	36.0	33.0	30.25	27.5	27.5	25.0	20.25	18.0
Area through each bridge wall retort, sq.in.	820.0	756.0	761.0	702.0	648.0	594.0	544.5	495.0	495.0	450.0	364.5	324.0
Area between bridge wall and deflection arch, sq.in.	2448.0	2448.0	2040.0	2040.0	1770.0	1770.0	1484.0	1484.0	1326.0	1326.0	984.0	984.0
Area under deflection arch	3280.0	3024.0	3041.0	2808.0	2592.0	2376.0	2177.0	1979.0	1979.0	1800.0	1457.0	1296.0
Area of tubes, sq.in	1011.0	1011.0	967.0	967.0	769.0	769.0	593.0	593.0	505.0	505.0	396.0	396.0
25% over flue area	1264.0	1264.0	1208.0	1208.0	961.0	961.0	741.0	741.0	631.0	631.0	495.0	495.0

Notes—First grade of firebrick to be used throughout with the exception of the combustion chamber floor and the side walls of the chamber back from a point one foot behind the rear face of the deflection arch. Fire-doors MUST provide for special air admission of an area equal to 4 sq.in. for each square foot of grate surface, when working pressure on boiler is 20 pounds or less. If desired, these doors may be used on boilers carrying more than 20 pounds pressure. Make the effective area through damper frame not less than the combined area of tubes. See ordinance for breeching and other regulations. Table applies only for the ordinary conditions and is subject to revision or modification for unusual conditions. Heating surfaces are in square feet, areas in square inches, except for grate surface.

ings (see Fig. 3). The blower is opened very lightly and the opening increased as the coal becomes ignited. The fire-door is kept open until after the coal is burning, or longer, depending upon the condition of the stack. Sometimes more coal is needed before a good fire is had,

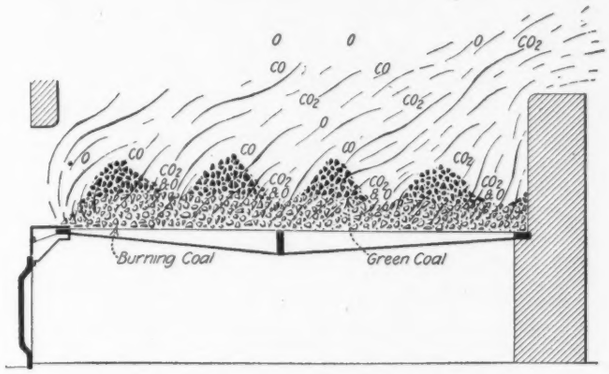


FIG. 6. COAL COKING IN SMALL PILES

and if so, wet low-volatile coal is used. The gas coal is used to prevent the low-volatile coal from falling through the grate.

This method of building a fire is correct from every viewpoint. The fire burns from the top down, causing the volatile to pass through a zone hot enough to completely gasify the vapors. The fire should not be sliced or hooked or otherwise disturbed. The method is applicable to a stationary boiler, and although the low-volatile coal may not be easily had, coal from the everyday

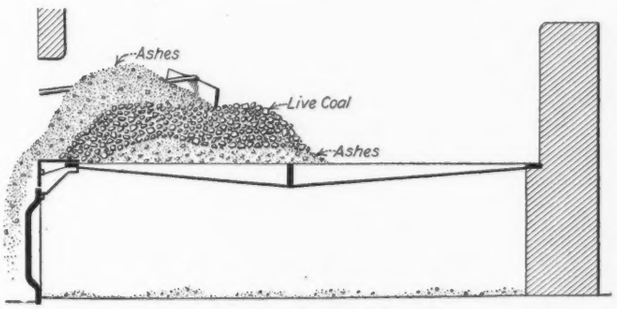


FIG. 7. BACK HALF OF GRATE CLEANED FIRST

supply will do. Fig. 3 shows the method applied to a stationary boiler.

Maintaining the fire between cleaning periods requires no mean skill. The coking method with which every fireman who reads should be familiar is not always the best. A glance at Fig. 4 shows that only a small part of the total surface of the green coals coking is exposed to the direct heat of the furnace. If the pile of coal coking could be left there long enough, the volatile would be driven off so slowly as to make no objectionable smoke. But it must soon be pushed and spread over the hot fire, and when this is done the volatile in the coal beneath the surface of the pile has reached a temperature where only a slight increase is needed to make it give forth its vapors so suddenly as not to give time for adequate mixing with air, thus making dense black smoke. The lowered furnace temperature also helps to make smoke at this time. All this is clear when we realize that the rapidity of distillation depends, for any given temperature, upon the surface of coal exposed to the heat. Less smoke will be made, even with a "puffy" coal if the pile is spread as in Fig. 5, and if steam-air jets or other means of getting air in over the fire are used.

The alternate method of covering has the same disadvantage, in that the green coal, even though thrown on but one-half or one-third of the fuel bed, has so much of its surface exposed at once to the incandescent coal that distillation is more rapid than can be cared for by the air admission. Unfortunately, too, these vapors should receive heat as they go on their way to the uptake instead of losing it. With this method the gases do not pass directly over an incandescent area, as they do when the coking method is employed. It has been suggested to throw the green coal in small piles well distributed over the burning fuel, and later, when most of the volatile has been distilled to level these piles (see Fig. 6). The idea is to gradually expose the whole charge of coal to the direct heat of the furnace. Theoretically the method is good,

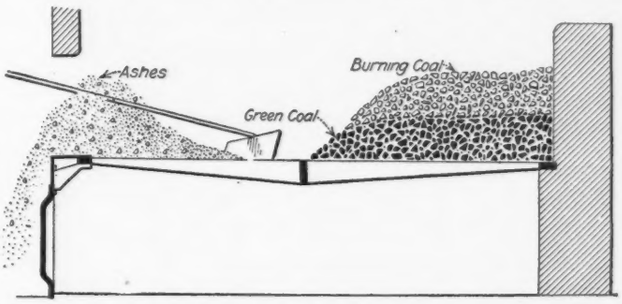


FIG. 8. CLEANING THE FRONT HALF OF THE GRATE

but it is hard work for the fireman and unfortunately gets him into the habit of disturbing the fuel bed with rake or slice bar, a most egregious fault.

Whether the coking, alternate, or the divided method of covering is used, or if the whole fire surface is covered at once, the covering must be thin and done frequently. This is particularly true of caking coals. Caking coals form the surface crust so peculiar to them during the coking process. The crust prevents sufficient air reaching the coal, and high spots form in the fuel bed. If

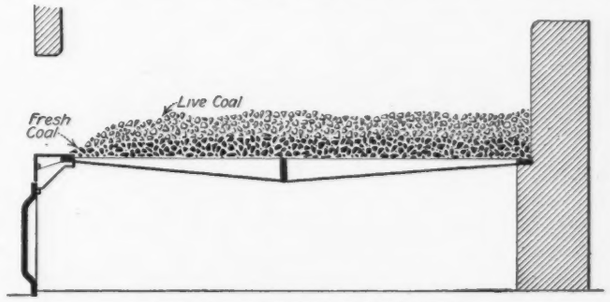


FIG. 9. THE FIRE CLEANED

these places are covered with fresh coal before the surface of the high spots have been broken and allowed to burn away, the trouble grows worse. Do not cover unburned places in the fuel bed. The troubles had with many caking coals may be made nearly negligible if the fire is always covered lightly and often. Use the rake and slice bar as little as possible, but remember that the crust of caking coal must be often broken, if formed, to maintain the desired steam pressure. When breaking the crust, be careful not to so disturb the fuel bed as to

get ashes on or near the top of the fire. Usually this causes serious clinker trouble, which stops the normal flow of air through the fuel bed and gives rise to more caking.

For a not too-heavy covering and at normal hand-firing combustion rates, it takes from 2 to 6 min. for the volatile to be driven off. During the major part of this time use the steam jet if provided or open the fire-door to admit air in above the fire. The time it should be left open depends, of course, upon the rapidity of distillation of the quantity of the vapor and gas distilled.

There is probably no more practicable satisfactory way of cleaning a fire than that shown in Figs. 7, 8 and 9. The back half of the grate is first cleaned as shown in Fig. 7, then about 3 in. of green coal is thrown on the bare grate and all the live coal pushed back on top of the green coal, which begins to burn from the top down, making it necessary for the vapors and gases to pass through the hot coal (see Fig. 8). The ashes are pulled from the front of the grate, green coal thrown on and the live coals at the back pulled forward and evenly distributed over the whole fuel-bed surface, Fig. 9.

Leaching Plant of Utah Copper Co.

The new leaching plant of the Utah Copper Co. is situated on a hillside, about 1200 ft. from the Magna concentrator, with the floor of the leaching tanks at an elevation of about 70 ft. above the track of the Magna plant coarse bins. It will consist of a crushing plant, a series of leaching tanks, a pumping plant for handling the leaching solutions, a water-service plant for furnishing the amount of water required, tanks for the storage of sulphuric acid, a precipitation plant and a sub-station for distributing the power required.

The crushing plant, with grizzlies and feeders in the receiving bin, is designed along the same lines as the coarse-crushing plants in operation at the Magna and Arthur mills, and the method of crushing and handling the ore through the crushers and rolls is practically the same as the one used at those two mills. After the ore, which contains copper in the form of carbonates, has been crushed to ½-in. mesh, it will be transported to the filling bridge at the leaching tanks by a belt conveyor. This conveyor is 700 ft. long, 42 in. wide, and has a capacity of 500 tons per hr. At the filling bridge the conveyor belt passes over a detachable tripper and is carried out on the filling-bridge conveyor. The filling bridge runs on top of the leaching-vat wall, and the belt conveyor on the bridge is provided with a self-propelling tripper, thereby making it possible, in combination with the movement of the bridge, to distribute the ore at any point in the leaching tanks. The arrangements are such that the filling bridge can be used to serve any future additions to the leaching tanks.

The discharging bridge will run on tracks that will be constructed alongside the leaching tanks for that purpose. It will be furnished with a grab bucket suspended under a light trolley, and when the bucket has been filled, it will travel over to a hopper into which it will discharge the tailings.

The hooper will be provided with mechanism so that either one of two lines of cars under it can be loaded. This bridge can also be used if the plant is ever extended to greater capacity. The discharging bridge will have a capacity of from 8000 to 10,000 tons of tailings in two shifts per day of 8 hr. each.

The first installation of leaching tanks will comprise 12 tanks, which will be built in two sections, each section to consist of six compartments, and each compartment will have a width of 50 ft., a length of 100 ft. and a depth of 18 ft. The foundation, the floors and the walls of the leaching tanks will be built of reinforced concrete, and the floors and walls will be lined on the inside with asphalt mastic to protect the concrete from the action of sulphuric acid in the leaching solution. Filter bottoms, consisting of lumber and cocoa matting will be installed on the floors of these tanks. The capacity of each tank will be approximately 4000 tons, and about 290,000 gal. of solution will be required to fill the voids and cover the ore to a depth of 6 in.

After the crushed carbonate ore is placed in the tanks, it will be leached with a dilute solution of sulphuric acid, which will extract nearly all the copper that occurs in the form of carbonate. The solution-conduit system will consist of four rows of launders running at the top of leaching vats and three pipe lines at the bottom. The launders are made of redwood lead-lined, and the pipes will be made of redwood boiled in paraffin and machine-banded with copper wire; all fittings will be lead-lined. The launders will carry the precipitation and wash solutions, and the pipe lines will be utilized for applying the upward percolation of the first leaching solution, the fresh wash water, as well as for draining the various compartments of the leaching vat. The pumping plant and the water-service plant will have sufficient capacity to handle the solutions and the amount of fresh water required for the leaching plant when treating 4000 tons of carbonate ore daily.

The precipitation plant will be north of and below the leaching vats. The solutions will be drawn from the vats and run into a storage tank having a capacity for 24 hr. From the storage tank the solution containing dissolved copper will be run through revolving drums charged with scrap iron, and it is expected that two of these drums will be sufficient to precipitate practically all of the copper. After leaving the drum the solution will carry the precipitated copper into a classifier, and from there the solution will run to a Dorr thickener and then overflow to a system of launders containing scrap iron, where the remainder of the copper will be removed. The precipitates will be loaded into cars and shipped to the smeltery for treatment.

The capacity of the twelve compartments of the leaching tanks will be from 2000 to 4000 dry tons daily, depending upon the length of time required for one complete cycle of operation. However, it is hoped that the charging, leaching, washing and discharging can be done within a space of time that will give the twelve leaching tanks a capacity of 4000 tons of carbonate ore daily. On the basis of 4000 tons, it is estimated that the amount of copper precipitated daily will be about 40,000 lb. The site chosen for the plant will permit of at least doubling its capacity at some future time if it seems desirable to do so. If the leaching capacity is doubled, and if it should then prove more satisfactory to install an electrolytic-precipitation plant, instead of doubling the iron-precipitation plant, such a plant will be constructed. It is expected that this leaching plant will be ready for operation during the spring of 1917.

The Assayer and Chemist

Detection of Calcium

A method for the detection of calcium in the presence of barium and strontium, where all are present as carbonates, has recently been worked out by P. N. Raikow (*Chem.-Zeit.*, 1916, Vol. 40, p. 781; abstr. *Journ.* Soc. Chem. Ind., Oct. 31, 1916). The material is heated for a few minutes in an open porcelain crucible over a Teclu burner, the product stirred, when cold, with a few cubic centimeters of water, the mixture filtered and the filtrate tested with phenolphthalein. An alkaline reaction indicates the presence of calcium. Under the conditions stated, strontium and barium carbonates are not altered, but calcium carbonate is readily decomposed, as little as 0.2% being detected with ease.

Lead Determination as Molybdate

In determining either lead or molybdenum by precipitation as lead molybdate, Harry B. Weiser states (*Journ. Phys. Chem.*, Vol. 20, pp. 640-2) that the precipitate using a solution of lead nitrate or the salt of some other strong acid is more granular and less bulky and consequently more easily handled than if it is formed with the use of lead acetate, which he explains on the basis of the solvent action of the nitric acid formed on the salt.

For the determination of lead the following method was found to be accurate: The solution should preferably contain about ½ gram of lead to 200 c.c.; add 8 drops concentrated nitric acid, heat to and keep at boiling while adding a 2% solution of ammonium molybdate slowly and with constant stirring. Avoid any great excess. Neutralize the solution with ammonia, barely acidify with acetic acid, wash the precipitate with hot ammonium-nitrate solution until the addition of lead acetate to the filtrate produces no cloudiness and ignite at a dull red heat, $PbMoO_4 \times 0.56415 = Pb$.

Separation of the Tin Group

The separation of the sulphides of the heavy metals is still, in practice, an unsatisfactory operation. J. M. Welch and H. C. P. Weber give a method embodying some new features in the *Journal* of the American Chemical Society, 1916, Vol. 38, p. 1011; abstr. *Journ. Soc. Chem. Ind.*, June 30, 1916, p. 708.

The mixed sulphides of the copper group are treated with ammonium-polysulphide solution containing 5% of caustic soda, which has no effect on the sulphides of mercury and copper, and the sulphides of arsenic, antimony and tin, reprecipitated from the filtered solution, are superficially dried, by suction or with filter paper, and heated for 10 minutes on the water bath with 10 c.c. of hydrochloric acid of sp.gr. 1.2. The residual arsenic sulphide is examined in the usual way, and the filtrate, diluted to 70 c.c., is saturated with hydrogen sulphide; antimony and tin are thereby thrown down together, when both are present, as a characteristic brown precipitate (possibly a thioantimonite of tin), the color of which, within rather wide limits, is a reliable indication of the presence of the two metals. Excess of hydrogen sulphide is expelled by heating, 5 c.c. of 3% hydrogen-peroxide solution is introduced, and heating is continued until the precipitate has redissolved, or solution may be effected by simply evaporating the mixture, without hydrogen peroxide, or by adding a few drops of bromine water. Five to ten grams of oxalic acid is then added, and the solution, while cooling, is saturated with hydrogen sulphide. Antimony is thus precipitated as a bright-red sulphide, and tin is detected in the filtrate by boiling with 1 to 2 grams of granulated lead for 2 to 3 minutes, cooling, and filtering into mercuric chloride solution.

Analysis of Tungsten Derivatives

Peculiar difficulties are met with in connection with the separation of phosphoric and vanadic acids from molybdic and tungstic acids. O. R. Sweeney, in the *Journal* of the American Chemical Society, states that in presence of a tungstate, arsenic is expelled only with great difficulty from an arsenate, even when heated in a stream of dry hydrogen chloride. By heating at a temperature a few degrees below that at which the volatilization of tungstic acid takes place, however, all the arsenic can be removed; antimonio-tungstate, when treated in a similar manner, gave concordant results. When dry hydrogen chloride was passed over a sodium vanadio-tungstate, the vanadium volatilized as a red vapor condensing to a reddish-brown liquid, the oxy-chloride. The appearance of the red vanadium oxy-chloride proved a delicate test for vanadium. For estimating the vanadium after volatilization, the volumetric method using potassium permanganate was found best suited to the conditions of the experiment.

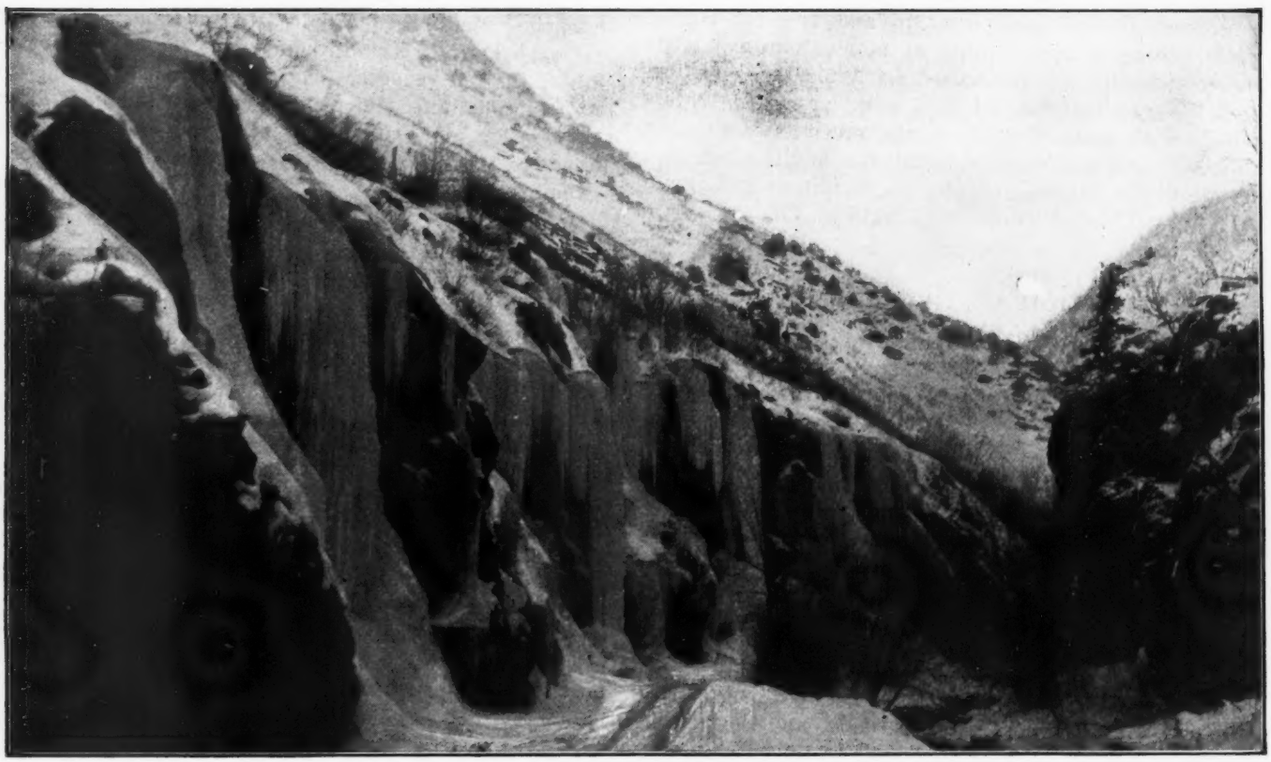
Producing Accurate Glass Tubes

Burettes, measuring cylinders, apparatus for gas analysis, and other measuring appliances made by Küpper's process (German Pat. 292,737; English Pat. 20,192 of 1913), have been tested, according to a writer in *Zeit f. Angew Chem.*, noted in the *Journal* of the Society of Chemical Industry, Nov. 30, 1916, and it has been found that they are accurate to 0.001 mm.

The process consists in placing a core, of the same diameter as that desired for the interior of the tube, inside an ordinary glass tube, which is sealed at both ends and evacuated. The tube is then heated externally until it shrinks onto the core and is thereby given the required internal dimensions. The core is then removed, leaving a tube which is so accurate in size and so uniform in diameter throughout its whole length that it may be engraved at once with a scale placed alongside and without the need for calibration, such as is necessary with ordinary tubes.

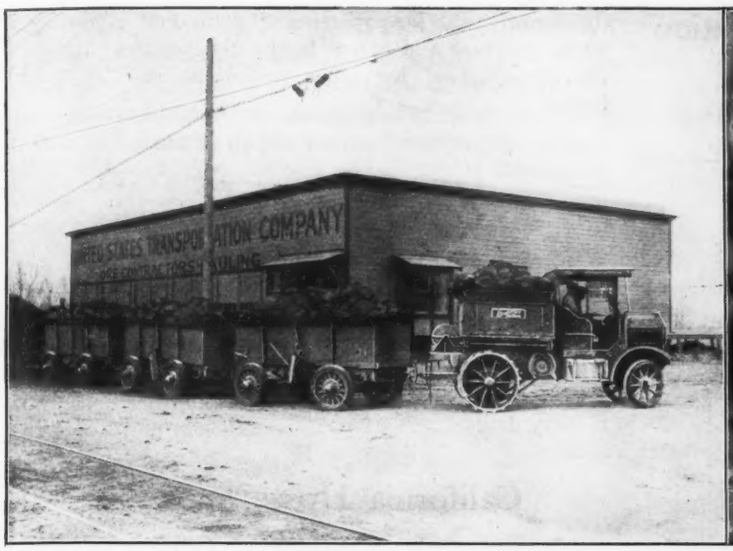
Transportation of Ore in

BOBSLEDS NOW BEING USED TO HAUL ORE FROM CARDIFF MINE

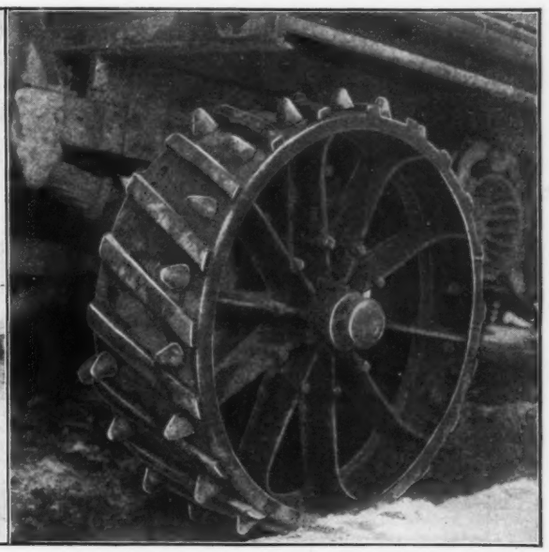


ROAD NEAR MOUTH OF BIG COTTONWOOD CAÑON, UTAH

Big Cottonwood Canon, Utah



COAL LOADED FOR CARDIFF MINE



TRACTION WHEEL WITH REMOVABLE CALKS

KNOX TRACTOR TRAINS HAULING 22 TONS OF ORE; TWO TRIPS DAILY

Details of Practical Mining

Chart for Finding Air Consumption of Drills

By Robert S. Lewis*

The accompanying chart is a modification of the one appearing in "Rock Drilling," by Dana and Saunders, with the addition of data for hammer drills and basing the diagram on an air pressure of 90 lb. per sq.in. at the drill instead of 75 lb., to conform more nearly with the requirements of modern practice.

The inclined lines are based on a sea-level datum and 90 lb. pressure per sq.in. at the drill. This gives a factor

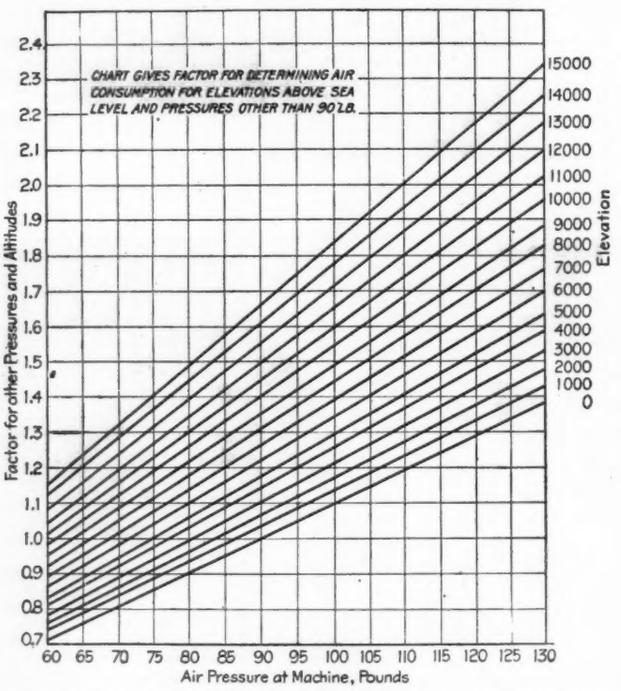


CHART FOR FINDING FACTORS FOR AIR CONSUMPTION OF DRILLS

of 1; for any other altitude or pressure at drill, the factor is found at the left margin, passing there from the intersection of the inclined line of the given altitude with a vertical through the given pressure.

TABLE 1. AIR CONSUMPTION OF ROCK DRILLS, CU.FT. PER MIN.

90 Lb. at Sea Level. Piston Drills

Drills, in...	2	2½	2¼	2⅝	2¾	3	3½	3¾	3½	4½	5
Cu.ft.....	68	87	92	98	118	125	129	136	161	210	250

90 Lb. at Sea Level. Hammer Drills

Stopers	Drifters	Sinkers	Block Holing	Hitch Cutters
48–55–58	40–60	38–60	25–30	15–25

The average consumption of air for both piston and hammer drills is given in Table 1. Hammer drills vary so in air consumption that only general figures can be given. Catalogs from drill manufacturers will give the consumption for any particular drill, and generally at 90 lb. pressure and at sea level. By means of the chart the consumption for other conditions can be quickly found.

TABLE 2. AIR CONSUMPTION FOR MORE THAN ONE DRILL

No. of Drills...	1	2	3	4	5	6	7	8	9	10
Factor.....	1.0	1.8	2.7	3.4	4.1	4.8	5.5	6.1	6.7	7.3
No. of Drills...	11	12	15	20	25	30	35	40	50	60
Factor.....	7.8	8.4	10.3	12.8	15.1	17.3	19.7	22.0	26.5	30.5

In case more than one drill is used, the factor by which to multiply the air consumption of one drill to determine the consumption of a number is to be taken from Table 2. This is based on manufacturers' statements. When a number are working, they are seldom all running at the same time. This table covers the requirements from one to sixty drills.

*Associate professor of mining, University of Utah, Salt Lake City, Utah.

California Horse Snowshoe

By S H. Brockunier*

The snowfall in the Sierra Mountains of California is usually quite heavy, but as the temperature is never very low, the snow seldom attains the firmness that it does in more northern climates. The engineer accustomed to doing most of his heavy hauling in winter as in Canada, will find different conditions in California. The snow is so moist that the country is almost impassable except on a packed trail or broken road. His webfoot snowshoes have to be replaced by 7- or 9-ft. skis, and his pack, even on the broken roads, will have to be cut down to the minimum during January, February and March.

The unevenness of the temperature—a few days of 15° to 19° F. above zero, followed by perhaps a week of 30° to 34° above zero—causes the roads to be subjected to a continual freezing and thawing action so that the hard-packed trail of today may become soft tomorrow.

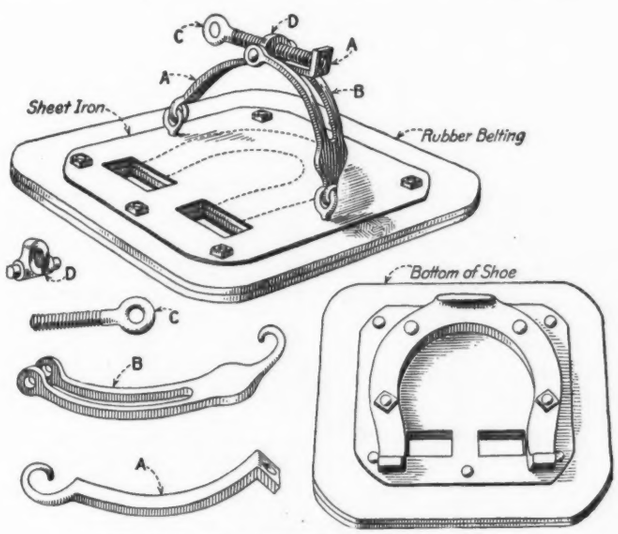
To offset this condition, the Californian puts his horses on snowshoes, and their aptitude for these snowshoes and the progress they make over any depth of snow are remarkable. A horse of steady nerve, one that is going to make a good snowshoer, will learn the trick in half an hour; others may never learn it. A pair of horses, either in span or in tandem, wearing sets of snowshoes, can go along 4 or 5 mi. per hr. with 500 to 1000 lbs. of freight, where horses without snowshoes would flounder.

These snowshoes are simple and easily made and are attached over the ordinary horseshoe in a few minutes' time. The shoes, as shown in the accompanying drawing, consist of a plate of sheet iron, ⅛-in. thick and 9 in. square, the corners being rounded. This plate has two 1x1½-in. rectangular slots cut through it 1½ in. apart. These are for the heel calks of the ordinary horseshoe to fit in and are made long so as to accommodate horeshoes of different sizes. Eye-bolts are bolted through the plate, near the center of two edges, and in these the hooks of

*Mining engineer, Nevada City, Calif.

the clamps, which hold the hoof firmly to the plate, are inserted. Beneath this iron plate are two thicknesses of 5-ply rubber belting 11 in. square, with rounded corners, and underneath the belting is a large horseshoe 9 in. long. Plate, belting and horseshoe are firmly bolted together by ¼-in. bolts, and the eye-bolts already mentioned also traverse the plate, belting and horseshoe; thus all are rigidly bolted together. The only thing to which there is any wear is the belting, which is readily replaced when it wears down to the size of the iron plate.

The clamps are quite easily forged out of $\frac{5}{16}$-in. flat iron and conform to the shape of the front part of a horse's hoof, around which they are to fit. One side, or strap, of the clamp is simply a quadrant of iron $\frac{5}{16}$ in. thick by ¾ in. wide by 5 in. long, with a corkscrew hook on one end and a square bearing shoulder on the other. This shoulder has a ⅜-in. bevel hole, at the base, drilled ⅛ in. into it, as a bearing for the screw in the other part of the clamp. The other side of the clamp is also a quadrant; it is $\frac{5}{16}$ in. thick, 1½ in. wide, and 5 in. long, has a corkscrew hook on one end and is split in a U-shape for half its length on the other end. This U is an inch



DETAILS OF A SNOWSHOE FOR HORSES

wide, and the metal on each branch of it is $\frac{3}{16} \times \frac{5}{16}$-in. section. Each arm of the U terminates in an eye, and a swivel rotates in these eyes. This swivel is drilled in the center and threaded for a ½-in. bolt. The bolt which works in this swivel is ½ in. diameter by 4 in. long; the end of the screw is made conical to fit in the bearing hole on the other half of the clamp, and the other end of the bolt is finished in a round eye, with a ½-in. hole, through which a piece of iron can be stuck to turn the bolt and thus tighten the clamp.

The whole is now assembled by placing the horse's foot in the position shown by the dotted lines, hooking one side of the clamp in one eyebolt of the plate and the other side of the clamp in the other eyebolt. Both sides of the clamp are now brought around the front of the hoof, the tongue of the clamp run through the U of the clamp, the end of the bolt brought to a bearing in the hole of the shoulder and the screw tightened. This holds the plate of the snowshoe between the calks of the horseshoe and the clamps of the snowshoe and attaches it rigidly to the horse's hoof.

The Amount of Concrete

Useful data for the concrete man are found in "The Concrete Dope Book" issued by the Cement Tile Machinery Co., of Waterloo, Iowa. Considering the size of stone or gravel, the following suggestions are given: Use anything up to 2½-in. diam. for foundations or thick structures. Use 1½-in. and under for thin walls and reinforced concrete. Use ½-in. or under for finishes or hard coatings. The best results are obtained from a careful mixture and grading of sizes.

The question of the amount of concrete required for different work often comes up. The rule devised by William B. Fuller is as follows: "Divide 11 by the sum of the ratios of all the ingredients (for a 1:3:6 mixture divide 11 by 1 + 3 + 6), and the quotient will be the number of barrels of portland cement required for 1 cu. yd. of concrete; the number of barrels thus formed multiplied respectively by the parts of sand and stone will give the number of barrels of each required for 1 cu.yd. of concrete, and multiplying these values by 3.8 (the number of cubic feet in a barrel) and dividing by 27 (cubic feet per cubic yard) will give the quantities of sand and stone in fractions of a cubic yard needed for 1 cu.yd. of concrete." A useful table based on this rule is given.

TABLE 1. MATERIALS FOR 1 CU.YD. OF CONCRETE

Proportions	Cement Bbl.	Sand, Cu.Yd.	Gravel, Cu.Yd.
1:2:4	1.57	0.44	0.88
1:2½:5	1.29	0.45	0.91
1:3:6	1.10	0.46	0.93
1:4:8	0.85	0.48	0.96

The cement, sand and gravel requirements are thus calculated by getting the volume of the required project and successively multiplying by the factors given in the table.

The accompanying factors on the handling of concrete are of evident use as a preliminary to any concrete work, and also to use as a check on the performance of concrete gangs.

TABLE 2. DATA ON HANDLING CONCRETE

Average load broken stone or gravel for wood wheelbarrow, cu.ft.	2.4
Average load sand for wood wheelbarrow, cu.ft.	2.5
Large load of broken stone or gravel for iron wheelbarrow, or short haul in concrete work, cu.ft.	3.0
Large load of sand for iron wheelbarrow, on short haul, cu.ft.	3.5
Average load of ordinary concrete for iron wheelbarrow, cu.ft.	1.9
Large load of ordinary concrete for iron wheelbarrow, cu.ft.	2.2
Number of shovelsful of concrete per barrel in average load	13.0
Number of shovelsful of concrete per barrel in large load	15.0
Average net time of one man filling wheelbarrow with concrete, min.	1.5
Quick net time of one man filling wheelbarrow with concrete, min.	1.0
Average quantity concrete mixed, wheeled 50 ft. and rammed, per man per day of 10 hr., cu.yd.	2.2
Large quantity concrete mixed, wheeled 50 ft. and rammed, per man per day of 10 hr., cu.yd.	3.0

In mill construction the quantity of concrete required for floors is conveniently calculated from Table 3.

TABLE 3. MATERIALS FOR 100 SQ. FT. OF CONCRETE FLOOR

	Base, 1:2½:5 Mixture					
Thickness in inches	2½	3	3½	4	4½	5
Barrels cement	1.10	1.30	1.50	1.78	1.99	2.21
Cubic yards sand	0.40	0.47	0.55	0.63	0.70	0.78
Cubic yards stone	0.80	0.94	1.10	1.26	1.40	1.56
	Wearing Coat, 1:2 Mixture					
Thickness in inches	½	¾	1	1¼	1½	2
Barrels cement	0.56	0.85	1.13	1.41	1.69	1.26
Cubic yards sand	0.16	0.24	0.32	0.40	0.47	0.64

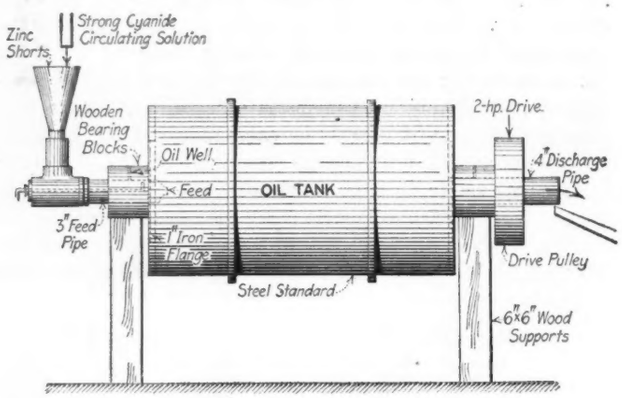
A cheap floor for light use can be made by laying 1 in. of coarse gravel and stone chips on a solid earth bottom and covering with an upper coat of 1:3 mortar ½ in. thick. This type of floor is not so satisfactory as the heavier construction, but is cheap and will do fairly well where there are no heavy weights.

Details of Milling and Smelting

A Tube Mill for Zinc Shorts

By Arthur C. Daman*

The tube mill for zinc shorts shown in the accompanying drawing is a good example of the mechanical ingenuity of some millmen. It was made of an oil tank and a few



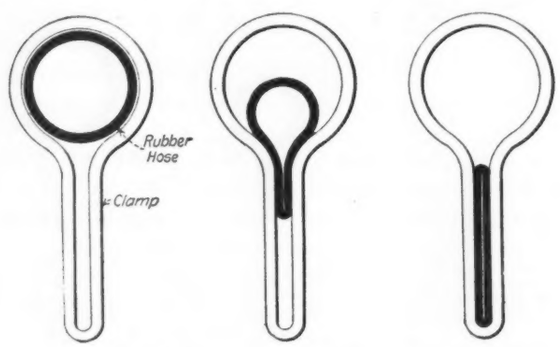
MILL FOR GRINDING ZINC SHORTS

pipe fittings, and for grinding zinc shorts prior to refining cyanide precipitates it has been a remarkable help. At first glance one would take it to be a miniature tube-mill.

Regulator for Hose Discharge

By A. W. Allen†

A simple type of regulator for discharge of hose is illustrated herewith. It is simple and can be made from 5/8-in. round iron at any mine shop. The construction is applied so that no sharp corners are formed in the hose,

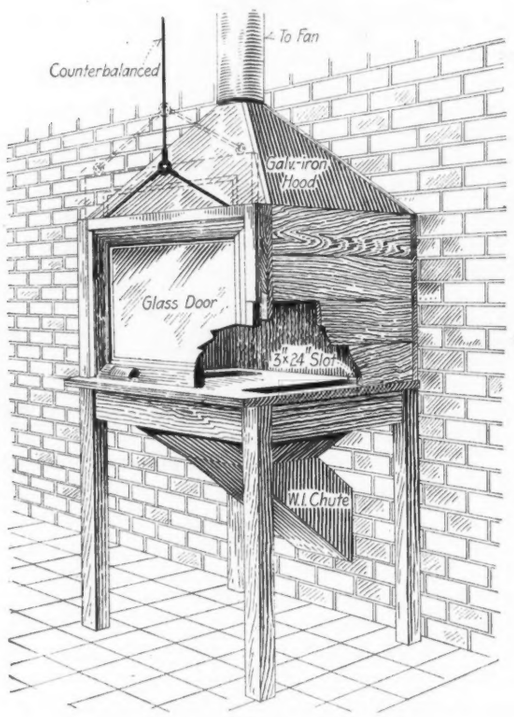


HOSE-DISCHARGE REGULATOR

and collection of solids is thus made impossible. Adjustment can be made instantly and without difficulty. The device is serviceable in all places where rubber hose is used to deliver or discharge water, pulp or air, such as on wash-water deliveries, the discharge from cone classifiers and air for regulation, where the hose is used to deliver it.

Sample-Quartering Table

Sample quartering necessarily gives rise to a considerable amount of dust in the air, and can well be conducted in a boxed-in space. Two forms of chamber are in use in South Africa. One resembles an ordinary fume chamber such as is used in chemical laboratories and is shown in the accompanying sketch from the General Report of the Miners' Phthisis Prevention Committee; the other has an inclined glass top. The chamber should be connected to the conduit through which air is



A DUSTLESS SAMPLING TABLE

drawn, or a jet of compressed air may create sufficient draft to draw off the air through a separate pipe. A pipe should always be provided, leading from the table to outside the room, through which the rejected portion of the sample can be discharged.

It is a useful plan to scatter damp sawdust over the floors of sample crushing and quartering rooms, as it tends to retain any dust that settles.

To Convert Pipe-Line Flow Figures given in barrels per hour into gallons per minute it is only necessary to multiply by 0.7.

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The Cerro De Pasco Mines, Peru*

SYNOPSIS—A review in brief of the history of the Cerro de Pasco copper mines and a statement of their present condition. The ore contains copper and silver as the metals of principal value, with some gold. The ore reserves provide for ten years' operation, but indications are for a much greater quantity as yet undeveloped. The company owns its coal mines and railroad lines, and includes the Morococha Mining Co., with large operations in the district of that name.

The Cerro de Pasco Mining Co. owns about 730 mineral claims comprising about 5900 acres, being the largest part of the mineralized area of the Cerro de Pasco district in the department of Junin, Peru. It is on the eastern slope of the Andes at an altitude of about 14,300 ft., and about 220 mi. by rail from Lima, the capital of Peru. The company owns in addition, extensive *haciendas,* amounting to about 70,000 acres, valuable water rights, power sites, surface rights and other valuable properties in the district.

Original Mining Operations in the District

When the Cerro de Pasco Mining Co. started operations, the mining developments consisted largely of hundreds of old gopher-hole workings, a few still open but many caved in and abandoned. The surface of the district shows scores of *tajos* resulting from the caving-in of these old workings. The largest of the *tajos* is called Santa Rosa. It is in the center of the district and is about half a mile in length, several hundred feet wide and between 100 and 200 ft. deep. Some of the old workings at one time reached a depth of about 300 ft., or to the level of the old Quillacocha drainage tunnel, and today in prosecuting the work of the modern development it is a common occurrence to run into these old workings called *bogacones.*

The Rumilliana drainage tunnel, about 150 ft. lower than the old Quillacocha tunnel, was begun in 1887 by Henry Meiggs, but work had been abandoned when the Cerro de Pasco Mining Co. began operations. Activities causing a revival of the drainage scheme, work was resumed and the tunnel was completed in 1907. In the meantime, however, the Cerro de Pasco Mining Co. had started scientific development of the lower levels of the district by shafts equipped with steam pumps and was carrying on extensive workings on these levels before this tunnel was completed. The company has continued its development work with an entire disregard for old workings, and the whole district has been opened up systematically by timbered shafts, winzes, raises, drifts, crosscuts and stopes. The aggregate of these workings at the present time is considerably in excess of 20 mi. Wherever required, complete equipment of pumps, air compressors and hoists have been installed.

The Esperanza shaft, having four compartments, is the main ore-hoisting shaft, but there are four other important ones—the Diamante, Carmen, Noruega and Excelsior—all equipped with modern hoists, pumps and air supply. The lowest levels at present worked are about 700 ft. below the collar of the Esperanza shaft. The Esperanza shaft hoist is now being electrified and is to have a capacity of 1600 ft. in depth; an entirely new electric hoist has just been purchased for Excelsior shaft, having a capacity of 1500 ft. About 1200 men are employed at Cerro de Pasco.

The ore reserves of the company are unusually large, considering the high-grade character of the ore. Up to a few years ago it was not considered advisable to block out a large tonnage ahead, because of the nature of the ore deposit and the cost of keeping the ground open. During the last four years, however, more attention has been given to the development work, and since annual reports have been started, the ore reserves have increased each year. The last annual report of ore reserves shows about 3,000,000 tons of first- and second-class ore, containing about 253,452,000 lb. of copper and 21,725,000 oz. of silver, besides the gold contents. Preliminary reports received during 1916 indicate that the next annual report will show larger ore reserves than any previous year. In connection with this estimate of ore reserves it must be borne in mind that only about 40% of the total smelter production is supplied by the Cerro mines, the other 60% coming from outside purchased ores and from the Morococha district. The engineers estimate that on the basis of past performances and present showing the positive and probable ore reserves at the present time are equal to about 10 years' supply. It is expected that the development now being carried on will increase these reserves.

Besides the main sulphide copper deposit being mined and treated at the smeltery, there is a large deposit, containing many millions of tons of low-grade oxidized silver ore averaging from 8 to 30 oz. per ton, not included in the estimate of ore reserves. Some of the richest of these ores are being mined and used as silica ores in furnaces and converter linings, and in addition, experiments are being conducted to determine the most economical process for extracting the silver values from the lower-grade oxidized ores. It is expected that all this large tonnage will ultimately be treated at a profit.

Geological Outline of the Deposits

In the Cerro basin, gray limestone, some dark carbonaceous shale and a little gray sandstone make up the sedimentary formations. An extensive intrusive mass of quartz porphyry is the principal igneous rock. A blanket of a fragmental igneous rock resembling volcanic tuff covers a large part of the area. Metamorphic material occurs abundantly. The sediments, as a whole, dip easterly. A strong zone of fracturing traverses the country in a general north to south direction. The intrusive mass of quartz porphyry with its capping of fragmental material lies in the western portion of the basin and forms the western wall of the great fracture zone. Limestone forms its eastern wall. Minor fissures extend in an east-west direction through both the limestone and porphyry and fragmental material to the west of the great fracture zone. Most of the ore produced at present is a black sulphide rich in copper and silver. A small tonnage of carbonate and oxide ore is also mined, in which gold is present as a minor accessory mineral.

*From an official statement made by the Cerro de Pasco Copper Corporation to the Committee on Stock List of the New York Stock Exchange

The sulphide ore is made up of two types: First, the semicrystalline sulpharsenates of the enargite-famatinite-luzonite series and occasionally a little tetrahedrite, gray copper, in a gangue of pyrite, silica and some barite, sphalerite and galena. The second type includes incoherent and granular sulphide composed chiefly of the aforementioned sulpharsenate and chalcocite, in a siliceous gangue. The carbonate ore shows both the copper carbonates, malachite and azurite, and some lead as cerussite. The red oxide of copper, cuprite, and possibly some of the black, melaconite, are present sparingly. The grade of the ore as a whole is unusually high. The occurrence of the ore is chiefly in veins or zones along fractures between walls of sedimentaries. The granular sulphide ore occurs in zones along the main north-south fracture. Carbonate ore occurs next above the sulphide, along the veins in some instances to a depth of 300 ft., and the oxidized ore extends from the carbonate zone upward.

The persistence in depth of values in known ore in this ground depends upon whether the minerals carrying those values are primary or secondary. If they are primary, the values may be expected to persist, regardless of secondary enrichment, to indefinite depth. In fact, primary ore minerals make up practically all of some veins and much of all others, so that the mineralogic evidence indicates that the ore will persist to an indefinite depth. The general facts as to the character and appearance of the Cerro ore deposits and the tentative conclusions which these facts warrant indicate that good, new ore probably exists adjacent to known bodies on their continuation along both the strike and on the dip, and also in virgin ground.

The Cerro de Pasco Mining Co. owns 108 coal-mining claims, comprising about 1865 acres. The two principally active operating districts are Goyallarisquisga and Quishuarcancha. The coal is of fair quality in both places and sufficiently good for smelting purposes. The total coal reserve at both camps amounts to about 3,052,903 tons. The annual requirement is about 300,000 tons.

The Smelting Plant and Auxiliaries

The smelting plant of the Cerro de Pasco Mining Co. is known as La Fundicion and is at Tinyahuarca, 9 mi. from Cerro de Pasco and on the main line of the Cerro de Pasco Ry. It is equipped with five blast furnaces, three reverberatories, four Pierce-Smith basic-lined converters, six Dwight-Lloyd sintering machines, fourteen MacDougal roasters and all other necessary auxiliary equipment. About 1300 men are employed at this smeltery, which started operations in 1906. At first difficulties were encountered in operating at such a distance and under new conditions of altitude, etc., so that it was not until the latter part of 1907 that the plant was brought to a regular producing basis. The company also owns and operates, at or near the smeltery, a coal-washing plant and 100 Lehigh ovens for making coke from its own coal for use in the copper blast furnaces. It has a good supply of limestone and maintains a plant for making silica brick and tile and pipe from a good fireclay deposit.

The total net returns for the smeltery production during eight years, 1908 to 1915 inclusive, for Cerro de Pasco, Morococha and other custom ores treated, amounted to about $64,300,000. Of this sum $50,000,000 was from copper, $11,000,000 from silver and $3,300,000 from gold. No other metals are recoverable in commercial quantities at the present time. During the eight years mentioned, the smeltery treated about 2,358,000 tons of ore and produced 340,000 lb. of copper, an average of 7.2%, or 144 lb. of fine copper per ton of ore treated. There was also produced during these eight years about 19,802,000 oz. of silver—8.4 oz. of silver per ton of ore, or 117 oz. per ton of copper. Also about 154,200 oz. of gold was produced, or about $\frac{1}{10}$ oz. per ton of copper. The highest yield of blister copper to date was in July, 1916, when over 3,250,000 lb. was produced, or at the rate of more than 55,000,000 tons of copper per year.

The Morococha Mines

The Morococha Mining Co. is one of the principal subsidiaries of the Cerro de Pasco. It is in the district of Morococha, which is an old mining country. In early times it furnished argentiferous lead ores and more or less gold. About 1870 an amalgamation and lixiviation plant was erected at Tuctu, just below Morococha. In about 1886 a new concentrator was constructed below Lake Huascacocha and the construction of a narrow-gage railroad was begun, to connect the concentrator with the mines. This railroad was never finished. Before 1894 the only copper ores worked in the district were sulphates from the oxidized ores of the San Miguel mine, for use in the Tuctu plant. In that year large-scale operations were started, and from that time the district was gradually converted into a copper camp, until now the argentiferous lead ores are practically neglected. The district rivals Cerro de Pasco as the most active and important metal-mining section of Peru.

Properties of the Morococha Mining Co.

The most important mines owned either wholly or in part or operated or leased by the Morococha Mining Co. are the San Francisco group, Natividad group, the Gertrudis, San Miguel, Amistad, etc. The company owns either wholly or in part about 6000 acres. The various mines are all opened by many short tunnels and shallow shafts, the longest tunnel being the Carlos Reynaldo, which starts at Tuctu and runs under Morococha Lake for about 4200 ft. and connects with the San Francisco shaft at a depth of about 470 ft. below the collar of the shaft. This tunnel is the lowest working operated by the Morococha Mining Co. and intersects the San Francisco vein at a depth of 1200 ft. from the highest surface outcrop of these veins. Above the collar of the San Francisco shaft the upper tunnel opens the upper portion of the ore zone from the apex down to the shaft collar. At present the following shafts are in operation by the company: San Francisco, Natividad, Gertrudis and the Amistad. They are equipped with modern electric hoists and electrically driven centrifugal pumps. The mines are systematically opened by tunnels, drifts, crosscuts, raises and stopes, and the ore is being extracted in a scientific and economical manner. About 750 men are employed.

The Morococha Mining Co. is supplied with ample power for all uses from the Cerro de Pasco hydro-electric plant at Oroya. The district is served by branch lines of the Central Railway of Peru, about 14 mi. long, connecting with the branch line at Ticlio. The smelting ores are shipped via the Central Railway of Peru to Oroya, junction point of the Cerro de Pasco Ry., and from there by the Cerro de Pasco Ry. to the company's smeltery. Because of the rapid and important growth of operations in

Morococha, which has increased from 20,000 tons of ore in 1911 to 115,000 tons in 1915, the blocking out of ore reserves has not kept pace with production, but the strength of the veins on the lowest levels and the mineralogically primary character of the ore itself indicate beyond reasonable question the persistence in depth and lateral extent of the veins in the Morococha camp. No exact tonnage of ore reserves has yet been compiled, but the engineers fix 10 years as a conservative basis for estimating equipment capacity for the future.

The geological formations in the Morococha district are made up of sedimentary, igneous and metamorphic rock. The sedimentary rocks comprise five lithologic divisions, embracing three of limestone, one of sandstone and one of shale. The thickness of these beds aggregates several thousand feet. The igneous rocks include intrusive and extrusive. The main types of intrusive are quartz porphyry, dioritic porphyry and diabasic material, and the extrusives are embraced in two chief groups, one of the basic lava flows, the other of metamorphosed material. The metamorphic rocks embrace those adjoining the intrusives characterized by a varied and extensive series of compact metamorphic minerals, and those adjacent to veins thus forming the walls of mineralized fissures. The sedimentaries and interbedded volcanics constitute a broad, flat arch. Athwart the central part of this arch the intrusives extend eastward to the central axis. Strong fractures of northeast-southwest course traverse these composite formations indiscriminately.

The chief minerals at Morococha are copper and silver. The ore minerals are the sulphides, enargite, tetrahedrite, chalcopyrite and bornite. As gangue mineral, pyrite, silica and rhodochrosite predominate. Some sphalerite is present, and the contact metamorphic silicates are common. Oxidized ore is scarce, though a little native copper is found.

The ores occur chiefly in two types of deposit: First, in metamorphosed limestone adjacent to intrusives, as contact metamorphic deposits, and second, in fractures of both the limestone and the intrusives as veins. The evidence at hand on the character of the primary ore affords good ground for believing that the values in the rich copper ore will persist in depth. The present reconnaissance survey of the geology of the Morococha mining district, with special reference to the geology of the ore deposits, indicates in general that more similar ore exists in the continuations of some of these known orebodies, both along their strike and on their depth, and that also within the limits of the company's grounds new bodies of similar ores exist in virgin ground.

The Hydro-Electric Power Plant

A hydro-electric plant was built in 1913 at Oroya, 12,200 ft., above sea level, at the junction of the Central Railway of Peru and the Cerro de Pasco Ry. It is equipped with three 4000-hp. (normal rating) waterwheels, and three 3760-kv.-a. generators. The normal capacity is about 12,000 hp. Power is transmitted to the smeltery, mines and coal properties at 43,000 volts. To meet the increased demand for power, an additional auxiliary plant of about 4000 hp., of the same type, is being installed about 10 mi. upstream from the Oroya plant near a place called Pachachaca. This plant will probably be in operation during the latter part of 1917, making a total of 16,000 hp. available for use at the properties.

The Cerro de Pasco Railway Co. serves the Cerro de Pasco Mining Co.'s mines, smeltery and coal mines. The main line, as has been noted, runs from Oroya, the junction point of the Central Railway of Peru, to Cerro de Pasco, the terminus, a total length of 83 mi. The branch line to Goyllarisquisga coal mine is 26 mi., to Quishuarcancha coal mine, 11 mi. In total there are about 135 mi. of single-track, standard-gage, line all laid with 70-lb. rails. There are 14 locomotives of American manufacture and 270 freight cars. About 420 men are employed in the railway departments.

Metallurgy of Zinc

We note the following summaries in *Chemical Abstracts*, of points of interest in the metallurgy of zinc:

Electrolytic Precipitation—Vilhelm Gruner, in *Tidskrift Kem. Farm. Terapi*, 13, 216-20, 232-6 (1916), says that zinc is electrolytically precipitated in compact form from pure acid solutions if sufficiently stirred. The zinc concentration may be as low as 2% and the acid as high as 30%. At a zinc concentration of 5% and acid concentration of 5% the maximum precipitation occurs when D_k = 500 amp. per sq.cm. Lowering the zinc concentration or increasing the acid concentration lowers the rate of precipitation. Increasing the acid concentration also lowers the electric tension. At about 10% the energy consumption per kilogram of zinc is at a minimum. The precipitation is somewhat facilitated by the addition of water glass, but the addition of hydrofluosilicic acid gives no advantage. Electrolytic zinc heated to just under its melting point is increased in volume from 15 to 20%. In most concentration the Zn-ion concentration is increased by the addition of H_2SO_4, provided, however, that this is not at a point where complex salts are formed.

Zinc Burning—The *Metallbank und Metallurgische Ges. Akt.-Ges.* in German patent, 290,013, Oct. 8, 1913 (addition to 252,195) says that the driving off of the zinc from the mixture of ore and fuel has been found to proceed more satisfactorily the smaller the excess of air in the heating gases entering the reaction chamber. Upon smelting the charge a portion of the zinc is held back by the slag which forms, while the reduced zinc vapor is reoxidized by the excess air to ZnO, which is dissolved by the molten slag. In order to overcome this difficulty, the process is carried out in a reducing atmosphere, avoiding fusion. In order that the highest possible temperatures may be used, the charge is mixed with ores or additions so that only a sintering results, without fusion. The CO_2 present in the heating gases has been found sufficient to oxidize the zinc vapors without excess of air. The zinc vapors may be oxidized by air subsequently.

Injuries to the Eye should be treated as follows, according to Miners' Circular No. 23 of the United States Bureau of Mines: If the eye is badly hurt, as by a blast, it is best not to try to remove the bits of rock, etc.; quickly cover the injured eye with a bandage compress (not picric-acid gauze) or clean cloth or cotton and tie loosely. Do not allow the patient to rub the eyes, but lead or carry him to a doctor as soon as possible. If the eye has merely a small piece of rock or other material in it, close both eyes for about half a minute and moisture from the eye may form and wash away the particle. If this remedy fails, close both eyes, pull the upper lid over the lower lid two or three times, close the nostril on the other side of the head with the finger, and blow the nose hard. Bandage the eye and wait for the doctor's aid.

St. Joseph Lead Co.

The President's annual report to the stockholders of the St. Joseph Lead Co., for the fiscal year ended Dec. 31, 1916, states that the year 1916 was memorable for abnormally high lead prices received by the company and a record production at the companies' mines, mills and smeltery. Employees and stockholders benefited from the resulting large earnings.

Dividends to the amount of $1,432,903 were paid. Distributions from the amortization reserve amounting to $2,149,074 were made. The smeltery produced during the year 91,073 tons of pig lead. The mills produced 169,302 tons of lead concentrates, 148,387 tons of which was shipped to the smeltery, and 20,915 tons to other smelteries. The mines produced 2,431,939 tons of ore. The proving of additional ore reserves by extensive diamond drilling gave encouraging results.

The $985,000 par value of Doe Run Lead Co. gold notes, due March 1, 1918, outstanding at last annual report, were purchased and cancelled and the underlying mortgage on the property of the Doe Run Lead Co. satisfied and discharged of record. The Doe Run Lead Co. paid on April 1, 1916, its outstanding notes of $53,000. The St. Joseph Lead Co. on July 1, 1916, paid its outstanding note of $5,000. During the year the company purchased and now holds in its Treasury or in the Sinking Fund $323,000 par value additional bonds of the Mississippi River & Bonne Terre Ry.

Amortization

In conducting a mining business, the ore reserves are a wasting asset which grows less each operating day and can only be replaced by the purchase of additional ore reserves.

It has seemed wise to the trustees that as nearly as possible the company's books should reflect these facts and that a reserve for amortization should be established to be used either for the purchase of additional ore reserves or to return to the stockholders the value of the capital invested in the business.

A careful engineering appraisal by well-known engineers has enabled the trustees to create such a reserve on a proper basis. The following broad general factors based on this careful engineering investigation were deduced: A capital value of $20,000,000; an estimated life of 20 years; an annual production by the companies of 2,000,000 tons of crude ore; an annual production from this ore of 80,000 tons of pig lead; as both costs and lead prices fluctuate, it was desirable to provide for this fluctuation in a reasonable manner.

The following resolution was passed by the trustees Nov. 4, 1915:

> Resolved, That whenever during the calendar year 1916 the company's monthly average sales price of lead exceeds $60 per ton East St. Louis, a charge of 2c. per ton of ore milled for each dollar of such excess be charged to Profit and Loss Surplus and credited to "Reserve for Amortization."

On Nov. 17, 1916, the period covered by this resolution was extended indefinitely. The balance sheet is now made up as follows:

Ore reserves and mineral rights owned by the company Mar. 1, 1913, are carried on the books at their appraised value as of that date (appraisal made by J. R. Finlay); purchases since that date are carried at cost; real estate, buildings and machinery at mines, dwelling houses, miscellaneous buildings, etc., are carried at book value; investments in subsidiary companies are carried at cost; a monthly charge to Profit and Loss in accordance with the foregoing resolutions has been and is being made; the Reserve for Amortization, or "reserve for depletion," is being carried as a *per contra* entry in the asset side of the balance sheet against Ore Reserves and Mineral Rights.

The labor conditions in the district have been satisfactory throughout the year. The bonus was increased from 10 to 20% in March and from 20 to 30% in April. This 30% is still being paid.

In December bonuses ranging from 5 to 25% were paid to the salaried employees of the company who were not already in receipt of the labor bonus.

New Construction

The principal new construction begun during the year 1916 was the following:

A new power plant at Rivermines which is equipped with two 3000-kw. General Electric steam turbo units, Heine boilers and modern coal handling machinery. At all mills additional flotation machines, Oliver filters for drying flotation concentrates and ball mills for fine grinding were installed.

At the smeltery a double roasting plant equipped with four Dwight-Lloyd machines, a Scotch hearth building equipped with 12 Newnam mechanical hearths, a powerplant addition equipped with a 1000-kw. General Electric steam turbo unit, and a Cottrell plant for the treating of roaster gases have been constructed.

The companies have licenses from the Dwight & Lloyd Metallurgical Co. for the use of the Dwight-Lloyd sintering machines; from the Minerals Separation American Syndicate, Ltd., for the use of flotation; from the Research Corporation for the use of the Cottrell system; from W. A. Butchart for the use of Butchart riffles, and from the St. Louis Smelting and Refining Co. for the use of mechanically operated Scotch hearths.

Future Policy

On May 1, 1916, the President made the following recommendations to the Board of Trustees:

> I should like to call the trustees' attention to the fact that the company has now reached a point of debt reduction which was agreed upon as a policy at the time the Consolidation Committee's report was accepted in September, 1913. There is no longer any short-term debt and the railroad mortgage bearing 5% does not fall due until 1931. The sinking fund on this mortgage calls for a payment of $50,000 on the first day of each January, keeping alive all the bonds called for the sinking fund, so that the sinking fund is alive and drawing interest at 5%. These sinking fund and interest payments will reduce the debt at maturity to $1,100,000. I should recommend that we set aside annually a further amount which would pay the debt completely out of the sinking fund at maturity. This would require an increase of the sinking fund payment of $75,000 per annum. I should further recommend the accumulation of a cash surplus of $2,500,000 as rapidly as possible and that the present dividend rate be not increased until this cash surplus is accumulated. I should further recommend that the plant at all times be kept in a thoroughly up-to-date and efficient condition and that whatever expenditures are necessary for this purpose should be appropriated from earnings. I believe that this policy in the long run is best for all the stockholders.

This recommendation was approved and a cash surplus of $2,500,000 was accumulated before the payment of the first amortization distribution in September.

American Institute of Weights and Measures

The enforced introduction of the metric system in the United States, making it by legislation the only legal system of weights and measures after a certain date, as has been proposed by several bills that have been introduced in Congress, is regarded by many industrialists and engineers as a threatened calamity of the first order. Such legislation would not merely mean the use of different kinds of weights and measures, as its advocates carelessly think, but would involve and lead to changes of the thousands of standards of materials and all sorts of units upon which our industry is based. Manufacturers would be confronted by the necessity of changing gages, patterns, etc., at costs running to a million dollars even in individual cases. Engineers would lose the old factors and data of work, material, costs, etc., which from long experience have accumulated in their minds. Such records as are inscribed in Trautwine would be rendered useless, and so would it be with much of our engineering literature.

After their overwhelming victory of a dozen years ago, the opponents of the metric system went to sleep. Not so, however, with the metric party, which has continued its publication of assumptions, while the public, to whom the extended investigations necessary to refute these false statements are impossible, has been misled and deceived. Last spring came the remarkable and wholly misleading report of Dr. Stratton, director of the Bureau of Standards, on the metric system in export trade and with it the realization that insidious methods were being employed to foist the metric system on this country.

Following these disclosures the opposition awoke, and under the leadership of Henry D. Sharpe several meetings were held with the result that the organization of a defense association was decided upon. This has been organized as the American Institute of Weights and Measures.

The objects of the new Institute are declared to be:

The maintenance and improvement of our present (English) system of weights and measures, for the good of our commerce and industry and the well-being of our country.

The education of the people with respect to the importance of our weights and measures, through the dissemination of correct information with respect to them and to the danger inherent in changes of our basic standards of measurement.

The improvement of old and the development of additional standards as they may be needed by reason of new conditions in commerce, industry, science and engineering.

The promotion of wise legislation for the conservation of our basic English units of weight and measure and opposition to hasty and ill-considered legislation involving changes from our fundamental English standards.

The annual dues of the association members are $100 for associations which are national in scope and $25 for all others. The annual dues of corporation members employing less than five hundred employees are $25, and of those employing more than five hundred and less than one thousand employees are $50, increasing at the rate of $25 for each additional thousand employees or fraction therefore up to a maximum of $500. The annual dues of individual members are $5.

The members of the council are: John F. Farrell, superintendent of weights and measures, State of New York; Fred A. Geier, president, Cincinnati Milling Machine Co.; E. M. Herr, president, Westinghouse Electric and Manufacturing Co.; Alexander C. Humphreys, president, Stevens Institute of Technology, past president, American Society of Mechanical Engineers; W. R. Ingalls, editor, *Engineering and Mining Journal*, president, Mining and Metallurgical Society of America; D. H. Kelly, secretary, Toledo Scale Co.; Harry M. Leland, president, Cadillac Motor Car Co., past president, Society of Automobile Engineers; William Lodge, president, Lodge & Shipley Machine Tool Co.; Walter M. McFarland, Babcock & Wilcox Co.; Henry D. Sharpe, treasurer, Brown & Sharpe Manufacturing Co.; Stevenson Taylor, president, American Bureau of Shipping, past president, Institute of Naval Architects and Marine Engineers; Charles N. Thorn, president, Inter-Continental Machinery Corporation; Henry R. Towne, president, Yale & Towne Manufacturing Co., past president, American Society of Mechanical Engineers; W. H. Van Dervoort, president, Root & Van Dervoort Engineering Co., president, National Metal Trades Association; Worcester R. Warner, vice-president, Warner & Swasey Co., past president, American Society of Mechanical Engineers.

At a meeting on Feb. 19, 1917, the following officers were elected: W. R. Ingalls, president; Henry D. Sharpe and D. H. Kelly, vice-presidents; Walter M. McFarland, treasurer. Frederick A. Halsey was appointed secretary and commissioner.

The Strike at Anaconda

The great damage that can be done to legitimate industry through hasty and ill-advised action on the part of labor unions and especially where two labor organizations are at war with each other, has been illustrated again in the Butte district, says the *Boston News Bureau*. On the afternoon of Feb. 6, 82 men, consisting of 24 cranemen and 58 electrical workers employed at the Washoe smelter of the Anaconda company, laid down their tools and walked out.

They had no grievance against Anaconda. Wages and hours were satisfactory. Their difficulty was with the mill and smeltermen's union. The latter for the past 10 years has had jurisdiction over the cranemen in the smelters. Anaconda in its contract with the mill and smeltermen's union recognized that jurisdiction.

Then the electrical workers came in and claimed jurisdiction over the cranemen. Some of the latter refused or neglected to pay their dues to the mill and smeltermen's union and the company, when called upon by the latter union to do so, let the men out.

The electrical workers claimed that the men must be put back to work. To meet their demands the company would have been compelled to violate its contract with the mill and smeltermen. It refused to do this and the walkout followed.

Anaconda is seeking to have the American Federation of Labor to which all the contending parties belong, settle the trouble. Unless the labor men get together, the company will have no recourse except to follow the lines it adopted when the old miners' union got into a war with the Butte mine workers' union two years ago. That trouble resulted in the open-shop system in the mines there.

Vice-President C. F. Kelly of Anaconda says:

"The company wishes to make it clear that it is in no way interested in this dispute, which is purely and simply a jurisdictional one. It also wishes to make it plain that

all trouble can be avoided if the cranemen and boilermakers' helpers will continue payment of their dues to the union to which they have belonged ever since the present agreements were made.

"The payment of dues by these men until the jurisdictional matter can be settled by the American Federation of Labor would involve no hardship and would also avoid loss of time and money with the possibility of involving thousands of their fellow employees at Butte, Anaconda and Great Falls.

"The novel situation is presented of a walkout by members of the electrical workers' union and the boilermakers' union in defiance of the laws of their respective organizations, and also their taking with them a body of men belonging to another union, because the parties to the written agreement existing between the company and the mill and smeltermen's union insist upon regarding it as binding."

Joplin District Ore Shipments

JOPLIN CORRESPONDENCE

The total amount of ore shipments from the Joplin district, including blende, calamine and lead, together with their value, has been set forth in the accompanying table. Comparisons of totals are made between 1916, and 1915, and the increased production shown:

JOPLIN DISTRICT ORE SHIPMENTS, IN POUNDS, 1916

Missouri	Blende	Calamine	Lead
Jasper County	505,141,750	4,234,940	77,443,640
Newton County	35,449,590	33,237,420	2,011,950
Lawrence County	6,742,830	9,490,770	314,940
Dade County	.....	3,867,610	.....
Greene County	.....	1,363,550	.....
Christian County	158,860	759,040	142,870
Howell County	.....	1,034,690	.....
Moniteau County	64,910	.....	.....
Totals	547,557,940	53,988,020	79,913,400
Oklahoma			
Ottawa County	102,087,540	218,670	30,693,490
Kansas			
Cherokee County	50,614,970	.....	4,759,580
Arkansas*	.....	3,733,690	35,220
Total, 1916	700,260,450	57,940,380	115,401,690
Total, 1915	597,699,980	51,357,650	93,225,380
Increase, 1916	102,560,470	6,582,730	22,176,310

Production of Potash in 1916

Statistics of the production of potash in the United States in 1916 are nearly complete, only a few of the important known producers having failed to report to the United States Geological Survey.

The total production of potash salts and potash products in the United States in 1916 was close to 10,000 tons of potash (K_2O).

The production reported to date for 1916 may be summarized as follows:

Mineral sources:	Available K_2O (short tons)
Natural salts or brines	3,850
Alunite and silicate rocks, including furnace-dust recoveries	1,900
	5,750
Organic sources:	
Kelp	1,110
Pearlash (mostly from hardwood ashes); only 23 producers have reported to date out of a list of 70 establishments said to be producing	220
Miscellaneous industrial wastes	1,750
	3,080
Total production	8,830

The largest output has come from the Nebraska alkali lakes, but the natural saline deposits elsewhere are beginning to make important contributions. The figures for potash derived from alunite, of which there is only one important producer, are combined with those for available potash in cement-kiln, flue-dust, greensand, and feldspar recoveries, in order not to disclose figures given in confidence. These do not include a considerable quantity of feldspar said to have been mined and prepared for possible use for the sake of the potash it contains.

The production of potash from organic sources is about half that from mineral sources. That from pearlash is an old established industry. A great deal of publicity has attended the efforts to obtain potash from kelp, but a similar organic source of high-grade potash salts has been quietly developed, which has proved more productive. Indeed, the reported production of a single establishment outranked the entire product of potash from kelp plants.

Mineral Output of South Dakota

According to the report of the state mine inspector, just issued, the mines of South Dakota had a prosperous year in 1916, in spite of a slight decline in the precious-metal production. There was a large increase in the output of the common minerals and especially of tungsten ore. The gold and silver production is reported as follows:

	Tons of Ore	Value
Homestake	1,600,220	$6,530,359
Trojan	107,789	353,553
Golden Reward	52,204	311,241
Mogul*	38,671	189,935
Wasp No. 2	50,035	89,906
New Reliance	13,524	49,892
Rattlesnake Jack	1,670	14,270
Columbia	151	5,436
Elk Mountain	6,000	10,862
Monarch	51	1,004
Miscellaneous	393	5,461
Placer	.....	1,707
Total	1,870,708	$7,563,632

* Includes over-production.

Tungsten-ore production is reported at 3899 tons valued at $391,851; mica (plate and scrap), 528 tons; lithia ore, 537 tons; tin, valued at $14,108; lead, 27,347 lb.; gypsum, 4070 tons; kaolin, 390 tons; pyrites, 80 tons; coal, 9000 tons; limestone and structural materials, valued at $226,250. A grand total of $8,273,080 is reported for the mining industry of South Dakota in 1916.

Big Ledge Copper Co.

The statements being circulated to the effect that I am writing a new report on the Big Ledge property are entirely false. I have not changed my views concerning that property in any particular since my report was written.

It is true that my attention was called to errors in the compass directions, such as east and west instead of north and south, and instead of making my corrections on the original, I had the report typed over again, using the opportunity to make my meaning unmistakably clear in a few paragraphs and excising the last paragraph of the report as unnecessary because in a preceding paragraph I had given my valuation of the property and did not deem it necessary to state the value per share which this amounted to.

I most emphatically deny that I have changed my views concerning the property or that I have any intention of writing a new report.

New York, Feb. 19, 1917. WALTER HARVEY WEED.

Editorials

The Situation

The situation is one of great confusion, great uncertainty. Therefore the recent stagnation in the stock market, the agency that reflects the opinions of business men all over the United States more accurately than anything.

The major factor of the moment is the trend of Germany's submarine campaign toward success or failure. If successful, which means a blockade of America's exports, the economic effect upon this country is bound to be great.

Another major factor is, of course, whether the United States will engage in hostilities with Germany, and if so, how?

A third great factor is the congestion of freight traffic on the railways and the establishment of an embargo. This has been attributed to the inauguration of Germany's submarine campaign, but a little reflection shows that manifestly it is not due to that, but to other causes.

The other causes are clearly overshipment for export, slackness of consignees in unloading, increasing inefficiency of labor, difficulties resulting from the severe weather, and finally absence of organization.

As the days of February have passed by, there has been a growing conviction that the German submarine campaign is falling far short of what was expected of it and of what is necessary to establish an effective blockade. With the apparent disappearance of this menace, there was a distinct increase in optimism here.

The railway embargo is probably but a temporary matter, one that may be cleared up in a month or so.

The prospect of war is not apparently regarded with forebodings of either commercial or financial trouble.

Copper, Lead and Zinc

In copper and lead we have reached simply the limit of things; that is commercially. Copper on the spot or for prompt delivery has been sold as high as 37c., lead as high as 11c. Such figures are without any broad commercial significance. They do not concern producers at all, for producers do not and cannot derive any benefit from them. The markets are sometimes referred to in this juncture as being "cornered." They are not cornered, for that expression implies a segregation of ownership of supplies, which will be released if anybody bids high enough. In copper and lead at present there are no considerable supplies for early delivery. There are no corners, but simply a sold-out position. It is analogous to all the seats in the theater being sold out. A speculator may hold two or three which he will sell at an advance of 50%, and someone determined to go to the theater at any price may pay what is demanded, but most people will not do so and go home. Thus it has been with consumers, who, finding themselves unable to get copper and lead, especially the latter, have closed their plants. This acute situation in lead is due to the freight congestion more than to anything else. Ever since last November lead has been delayed in coming from the West, and an immense quantity is now locked up in railway cars. If this could be released, the shortage would be quickly relieved, without any doubt. At present there is on the railway cars between the Mississippi River and the Atlantic seaboard about three times the quantity of lead that is normally in transit, if the figures communicated by some producers are indicative.

It should be clearly understood that the high prices that have been talked about, and that have undoubtedly been paid, represent transactions in relatively trifling quantities on the spot. The great bulk of the lead is being delivered to consumers on average price contracts. The American Smelting and Refining Co. maintains its price at 8½c. and delivers lead to its customers on that basis. Its position and its reasons are the same as about a year ago in a juncture that was similar, although arising from different causes. Undoubtedly it considers that it is not justified in strangling consumers by raising its price controlling the settlement of many thousands of tons monthly to figures representing transactions in only a few hundred tons, which figures would themselves be impossible, probably, if consumers had not entered into the contracts they have. Other large producers are treating their customers likewise. The attitude of the producers in this unprecedented situation both commands respect and appeals to common sense.

The situation in copper results primarily from the producers contracting last November for the bulk of their expected output in the first half of 1917. When a relative calm followed that tempestuous market, there was a position of some consumers being still uncovered while others were overbought. The decline in price that began about Dec. 12 resulted in a more or less equalization of that situation. Consumers who had overbought considered it wise to resell, and uncovered consumers bought. The readjustment seemed to have been completed, when the freight congestion, reducing refinery supplies, together with troubles such as strikes and breakdowns at the refineries, reduced the expected output, and moreover the severe weather tied up the shipment of copper from the refineries to Connecticut. For example, barges carrying considerable quantities of copper up the Sound were literally frozen in. Such things put some manufacturers in a position so awkward that they considered the shipment of considerable quantities of copper by express, but the aggregate of such business or the payment of prices of 35 @ 37c. per lb. were of course relatively trifling; and the realization of such prices was enjoyed only by a few speculators, whose transactions were devoid of any broad significance, just as the payment of $10 per seat does not reflect the general price for going to the opera in New York. The realization of such prices or even some hundreds of thousands of pounds is no argument for booming copper stocks, for the producers have sold out their houses, so to speak, at 26½ @ 27¼c. and what speculators may get makes no difference to them. In-

deed, the producers have been helping out, so far as they could, their customers who have found themselves in emergencies, at much lower prices, and the major market has not been higher than 33c. on the February advance.

Even that is too dizzy a price. Its maintenance is developing conditions that are impossible and dangerous. The market has worked itself into the position of the shipmaster's son whose predicament used to excite us in the Third Reader. Having climbed the mainmast, he stood finally on the truck and then knew not how to get down. The copper market is threatened with an equal peril of fall unless it can in some way be brought down in a relatively safe way. It would be better for everybody today if copper were around 25c. instead of being above 30c. We do not suppose that there is anybody who will deny that it has got to come down some day and will better come down easily than with a crash. What most concerns the producers now is how they are going to market their second-half production. They were gratified last week by some nibbling for July copper.

The situation in spelter is of course quite different from what it is in either copper or lead, for the reason that there is now a stock of spelter on hand and production has caught up with consumption and is very likely outrunning it. Winter difficulties in Kansas and Oklahoma and freight difficulties have played a part in strengthening the price for this metal from its last decline to 8¾c., but the strength is more sentimental, out of the belief that the political situation may result in a renewed demand, than is it real strength based on the statistical position, as in the cases of copper and lead.

Church and Peters

We have been grieved during the last month by the departure of two of our old friends, mining and metallurgical engineers of the highest distinction, both of whom had been closely associated with us in former years—John Adams Church and Edward Dyer Peters. The former was assistant editor of the *Journal* in the early days, under Rothwell and Raymond. For many years thereafter he was a valued contributor and coadjutor. Although in late years he gradually ceased to render such active assistance, he was a friend always. Similarly as to Peters. While never a member of the staff, he was ever an important collaborator. Out of the association grew his classic "Modern Copper Smelting" and numerous other contributions, both in the form of books and through the pages of the *Journal,* which were of powerful influence in the development of American metallurgy.

Both Church and Peters were shining examples of the best in the old school of mining and metallurgical engineers. To the same school belonged August Raht, the prince of lead smelters, who died only a few weeks ago. It was such men who created the arts of mining and metallurgy in America in the 70's and 80's. Nor did they fall behind in the later and marvelous developments of the 90's and the new century, except that inasmuch as they were growing older, they became naturally less active. But none of these men ever became a back number. Church gradually passed into dignified retirement, but this only in the last few years; while Peters died in harness as professor of metallurgy at Harvard, a chair that he had filled with great distinction for many years. The lives and works of these old friends, both stars in their professions, are models and inspirations for the younger generations. Church's work began half a century ago. Peters was not quite so old. Gradually are departing these links with the past. As one goes after another, we see in our friendship gaps that do not fill up, but in our memory there is no one missing.

American Institute of Mining Engineers

The annual meeting of the American Institute of Mining Engineers held in New York this week was a repetition of the great social successes that these meetings have been scoring in recent years. The reading of papers at these meetings and the discussion of them are rather minor events. Members get the papers in their bulletins and read them at leisure if they happen to be on subjects of interest. There is not much disposition to thresh out disputed questions in public. The chief function of these meetings is the bringing of members together, making them acquainted with one another. The great interest is therefore the human interest, as indeed it is in most things.

It is obvious that the more the spirit of fraternity and society can be cultivated in the Institute the better it will be. It is a comprehensive organization which takes in everybody who is interested in mining. Through its publications it plays a great part in the advancement of knowledge of the science and art of mining and metallurgy. Beyond these functions—which are big enough, anyway—it does not go. It does not concern itself with industrial or professional problems beyond the presentation of opinions of individual members through the medium of its transactions, nor does it act as a unit or engage in any propaganda. Those branches of activity pertain to the Mining and Metallurgical Society of America, a compact, professional organization, which is constituted to be a militant agent.

The American Institute of Mining Engineers, as the inspiration for the communication and dissemination of professional knowledge and as a social organization, serves a great purpose. May it increase and flourish forever and ever!

Amalgamation is being discontinued at the Treadwell gold mines on Douglas Island, Alaska. In the recent monthly reports of these companies there have appeared as income items such entries as, "Net value of copper plates, $32,517," for the Alaska Treadwell company in October and for the Alaska United company in the same month a similar entry amounting to $23,279.

Amalgamation is being discontinued at the Douglas Island properties, as it has been found that the gold so saved could be recovered with the sulphide concentrates. In consequence the companies have lately been melting up their copper plates and shipping them to the smelters in the form of bars. Thus it is that the strongholds of amalgamation have, one by one, given up to the newer metallurgy. Even the gravity stamp is now beginning to feel the loss of its first-line trenches to this later metallurgy. Few new gold mills of moderate size have been built in this country lately with stamps as the crushing apparatus, and several large mills have abandoned the stamp for rolls or cylindrical mills, sometimes with a combination of the two, or preceded by an intermediate crusher.

BY THE WAY

A Salt Lake broker is out with a general market letter with a new wrinkle. Attached to his letter is a picture post card in colors, giving a view of the mining district in Utah which the market letter is booming.

⁂

It is interesting to note the attitude of a state financier on the proposed state-mining scheme in South Africa. At a recent sitting of the State Mining Commission, Mr. Leisk, Secretary of Finance, testified that—given an overflowing treasury—he saw no objection to the financing of state mining from the general revenue in the same way as is already done with railways, telegraphs and telephones. Conditions at present were of course unfavorable, and he thought it unreasonable to expect for several years a surplus such as could be justifiably applied to state mining. It would be better to reduce the deadweight of debt created by the war, unless the Union of South Africa were willing to submit to enhanced taxation. He concluded, therefore, that state mining by the medium of ordinary revenue must be dismissed from the region of early practical politics.

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Under the caption "Mine Advertising for Rube Consumption" the *Saturday Night,* of Toronto, publishes the following boost: "Sixty cents now, the price will positively be advanced to 75c. per share after that date"—the date being Jan. 15. Such is some of the hot stuff in the advertising matter of the Tommy Burns Gold Mining Co. which is being published in our most religious and driest daily newspapers. Just think of a lot of philanthropists who are going to make you 15c. a share on Tommy Burns, all within a few days. A company that will do this should have a D.S.O., not to speak of a Military Cross. And to get this 15c. per share profit you do not even have to pay for the stock. You just send along 25% of the purchase price for a million shares or so, and you may pay the balance in three monthly installments. And then, not to be outdone in any department of philanthropy, the Tommy Burns company will give a free ride to the properties. If you are not satisfied after you have inspected the woodpeckers and the Christmas trees, you can have your money back. Great stuff this advertising. It should be set to music and played at the Mimico Asylum.

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The advertising methods used by the promoters of a number of recent mining flotations in Northern Ontario call for criticism. Extravagant statements, which have little foundation in fact, are freely made in an effort to entice the gullible public to subscribe for the shares. An instance of this was the offering of stock in the Cheney Copper Co. made by a firm of New York brokers. These brokers were given a report on the property, written by Robert A. Bryce, a reputable mining engineer, of Toronto. In their advertising literature they endeavored to convey the impression that Mr. Bryce was responsible for the statements made, although they were at variance with the facts as given in his report, he being in no way responsible for these extravagant claims. Mr. Bryce promptly severed his connection with the company, and upon representations being made by him to the directors and to the brokers, the advertising was withdrawn, and the brokers agreed to refund the amount of the stock subscriptions. Probably their intentions were all right in the first place, but in their inexperience they let their imagination discount the facts. It is not often, however, that affairs of this kind have such a happy ending as did this one.

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Same old stuff!—For several years W. E. Noble has freighted mine supplies through the Calico Cañon in Nevada. On his last trip, early in December, his wagon broke down, and as it was nearly time for camping, he hobbled his mules, built his fire, supped and rolled himself in his blanket and went to sleep. Toward morning he awoke, kicked the embers together and then noticed, against an enormous rock on the other side of the fire, a coiled rattlesnake, now aroused and threatening. The instant shot from Noble's revolver passed through the snake's head and struck the rock, chipping off a large scale and revealing, in the light of the fire, some glittering substance. Noble's experienced eyes told him that it was gold. With his ax he chipped off a few pounds of the mixed rock and ore, rode one of the mules into Elko and got an assay. It showed $150 gold and 900 oz. of silver to the ton. Two or three days blasting into the rock, revealed a true rich vein, and a party of men paid him $50,000 cash for his claim. Noble has driven past that rock some scores of times, and prospectors have prospected all through that cañon. Had that rattler been two feet to the right or left of where it was, that rich deposit would still be an unknown and unworked vein.

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An American mining engineer writes from our sister republic *al Sur;* "I have been in Mexico for some time investigating the conditions affecting the mining and smelting industry in the southern part of the country, trying to figure the probable costs of production under the new 'decrees' which constantly change the value of the currency, the rate of wages and the cost of railroad transportation. It is most interesting, but a rather complicated problem. I have been fortunate enough not to have been on any trains that have been attacked by Zapatistas, who are still very active in this part of the country, and I hope to return safely to New York before spring. The State Department refused to renew my passport, on the ground that the department's advice had been for all Americans to absent themselves from Mexico until further advice. Of course I hadn't expected any active help or protection to go with the passport, but I should have liked to have been able to prove my nationality in case of need. The trip by rail from Laredo to Mexico City takes three days instead of 35 hours as formerly, as there are two districts through which trains are not operated at night. Between Laredo and Saltillo the entire freight and passenger service is taken care of by four locomotives—mixed trains. The freight movement can be imagined. Between Saltillo and San Luis Potosi two cars of soldiers are attached to the passenger trains to ward off attacks by the Cedilla brothers, who are operating without apparent affiliation with any of the other revolutionists. I saw one of their followers, captured during a recent raid on the railroad, hanging quietly from a tree near the Charcos station.

Personals

Reginald Hore, of Toronto, was in New York this week.

G. A. Guess, of Toronto, visited at New York during the week.

Chas. B. Murray, of Cleveland, Ohio, visited in New York during the week.

B. F. Tibby, of Salt Lake City, was in New York, attending the A. I. M. E. meeting.

Dr. Otto Sussman of the American Metal Co. expects to leave for Chile in a few weeks.

John F. Spedding is now manager of the mines of the New Gangpur Mining Syndicate, Ltd., in India.

J. M. Anderson, formerly of Detroit, Mich., is being sought. Will he please communicate with this office.

F. H. Minard, of New York, is consulting engineer for the Mineral Hill Consolidated Copper Co., Tucson, Ariz.

Harold C. E. Spence, of Montreal, is at the Ritz-Carlton hotel, New York, where he will spend a few weeks.

Paul W. Gaebelein, superintendent for the Baker Mines Co., Cornucopia, Ore., was married at New York on Monday, Feb. 19.

J. B. Tyrrell, of Toronto, has been in New York, attending the 114th meeting of the American Institute of Mining Engineers.

Fred. G. Farish has taken over the management of the Mineral Hill Consolidated Copper Co., with headquarters at Tucson, Ariz.

J. L. W. Birkinbine, of Philadelphia, was present at the meeting of the American Institute of Mining Engineers at New York this week.

Professor J. W. Bell, of McGill University, Montreal, attended the meeting of the American Institute of Mining Engineers, at New York, this week.

Professor Robert H. Richards, of the Massachusetts Institute of Technology, was in New York this week on the occasion of the meeting of the American Institute of Mining Engineers.

E. J. Schrader, manager for the Pittsburg-Dolores Mining Co., Rockland, Nev., has fully recovered from operations performed upon him at Lane Hospital, San Francisco, in December, and is now back at Rockland.

Samuel W. Cohen, general manager of Crown Reserve Mining Co., Ltd., and Porcupine-Crown Mines, Ltd., consulting engineer for Dominion Reduction Co., Ltd., is now permanently located at the Dominion Express Building, Montreal.

Herbert C. Hoover addressed a gathering of mining engineers on Reunion Night, Feb. 19, one of the series of meetings comprising the 114th meeting of the American Institute of Mining Engineers. He also spoke at the banquet at the Hotel Astor, on the following evening.

D. F. MacDonald left Washington last week to take charge of the Bureau of Mines, station at Urbana, Ill. Mr. MacDonald is the mining geologist who reported on the slides at Panama for the Government. He is the author of a bulletin on Prospecting and Copper Mining Methods at Santa Rita, N. M.

The Committee of Consulting Engineers of the U. S. Bureau of Mines on Revision of the Mining Laws met in the Engineers' Club, New York, on Feb. 20, and organized with W. R. Ingalls, chairman and Hennen Jennings, vice-chairman. J. R. Jones, of the U. S. Bureau of Mines has been detailed to act as secretary.

General Geo. W. Goethals has opened consulting offices at 43 Exchange Place, New York, for practice in civil, electrical, mechanical and hydraulic engineering. He will be aided by a staff of experienced specialists. Gen. Goethals was retired from the Army on Nov. 15 under the law that gives an officer the privilege of retirement after 40 years of continuous service.

M. M. Duncan, general manager of mines for the Cleveland-Cliffs Iron Co., with headquarters at Ishpeming, Mich., has been named vice-president of the company. He will continue to reside in Ishpeming. He fills the office left vacant by the death of J. H. Sheadle, of Cleveland. Mr. Duncan has been with the Cleveland-Cliffs Iron Co. for 19 years, and under his direction the concern has grown to be one of the largest operators in the Lake Superior district.

Obituary

Hermann A. Keller, one of the most distinguished mining engineers of the United States, was struck and killed by a locomotive in a mine tunnel at Clifton, Ariz., on Feb. 16. We shall publish an extended biographical sketch of Mr. Keller in an early issue.

Henry Harcourt Van Cutsem, of London, England, died on Feb. 13, at the age of 38. He was well known in Canada in connection with Cobalt mining enterprises, as a member of the firm of Rose, Van Cutsem & Co., one of the largest owners of the Mining Corporation of Canada. Mr. Van Cutsem was one of the original promoters of the Cobalt Townsite Mining Co., which, with other properties was merged in the Mining Corporation. He leaves a widow and one son.

John L. Buell, who discovered the first ore on the Menominee, Michigan, iron range, and who opened the old Quinnesec mine, died at his home in Quinnesec, Feb. 1. He was born in Lawrenceberg, Ind., 1836. He studied in Norwich Military Academy, Vermont, and later entered Harvard law school. Was engaged in mining in Leadville in 1860. Later, he worked at the Pinos Altos mines, in New Mexico. Served with Fourth United States Infantry throughout the Civil War. He arrived in Michigan in 1865 and engaged in publishing business. His first visit to what is now the Menominee range was in 1873. A short time later he commenced exploring and found the first merchantable iron ore there and opened Quinnesec mine. He was a prominent figure in Lake Superior mining and newspaper circles for many years.

Professor Edward Dyer Peters, a member of the faculties of Harvard University and the Massachusetts Institute of Technology, and a well-known metallurgical expert, died at his home in Boston, Feb. 17, at the age of 67. Professor Peters was a native of Dorchester, Mass., and was graduated in 1869 from the School of Mines, at Freiburg, Germany, where he later received the degree of Doctor of Engineering. In 1877 he received the degree of Doctor of Medicine from Harvard University. In 1872 he was territorial assayer of Colorado, and he lectured on metallurgy at Harvard in 1903 and 1904. Later he was made a professor at Harvard and became attached to the faculty at the Institute of Technology. Dr. Peters was a fellow of the American Association for the Advancement of Science and a member of the American Institute of Mining Engineers. He was the author of "Modern Copper Smelting," "The Principals of Copper Smelting," and other technical works. A more complete biography of Professor Peters will be published later.

Societies

Engineers Society of Western Pennsylvania held its regular monthly meeting on Tuesday, Feb. 20, at the Pittsburgh Carnegie Library. A lecture was delivered on "The Aëroplane in Warfare," by G. L. Faulkner, lieutenant, Royal Flying Corps., British Army. This lecture will not be published in the society's proceedings.

American Institute of Consulting Engineers, at the annual meeting, held Jan. 15, 1917, elected A. M. Hunt, L. B. Stillwell, Wm. J. Wilgus and G. S. Williams members of the council. George Gibbs was elected president of the Council at the meeting on Feb. 6, and L. B. Stillwell, vice-president, and F. A. Molitor, secretary and treasurer.

The Ladies Committee of the American Institute of Mining Engineers gave a luncheon to Mrs. H. C. Hoover on Saturday, Feb. 10, at the Bankers' Club, at New York. In addition to the guest of honor, Mrs. W. L. Honnold was present. Mr. Honnold is closely associated with Mr. Hoover in the work of the Commission for Belgian Relief. Mrs. H. W. Hardinge, chairman of the ladies' committee, presided, and the entire committee was present. The committee, desiring to perform useful and patriotic work, resolved to organize all the ladies of the Institute so that in the event of war, they could perform whatever service seems most useful, and should there be no war, they will interest themselves actively in Belgian relief. It was resolved also to ask Mrs. Hoover to exhibit at the Engineering Building various articles connected with the Belgian work on Tuesday, Feb. 20.

Industrial News

Jenkins Bros., manufacturers of valves, New York, has elected Parnham Yardley, son-in-law of the late Alfred B. Jenkins, and formerly Vice-President, President of the company to fill the vacancy caused by the death of Mr. Jenkins. Frank T. Swain, general manager of the company, was elected Vice-President. Samuel Laird, Manager of the Phildelphia business, has been elected a director to fill the vacancy in the board.

Alberger Pump and Condenser Co. has opened a branch office at 1418 Pennsylvania Building, Philadelphia, Penn., in charge of H. W. Wetjen.

Atlantic Smelting and Refining Works has removed to 57-63 Richards St., Brooklyn.

P. H. & F. M. Roots Co., Connersville, Ind., has received an order for six No. 7½ horizontal high-pressure blowers, having a capacity each of 4800 cu.ft. per minute against 6 lb. pressure at 160 r.p.m., from the Miami Copper Co., Miami, Ariz.

Canadian SKF Co., Ltd., has been organized under Dominion charter for the manufacture and sale of ball bearings in Canada.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Alloys—Process of Producing Metallic Alloys. Michael A. Rebert, York, Penn. (U. S. No. 1,215,857; Feb. 13, 1917.)

Alkali Recovery—Process of Recovering Constituents of Value from Alkaline Deposits. Louis C. Jones and Fred. L. Grover, Syracuse, N. Y., assignors to The Solvay Process Co., Solvay, N. Y. (U. S. No. 1,215,543, 1,215,544, 1,215,545, 1,215,546, 1,215,574, 1,215,575; Feb. 13, 1917.)

Aluminum Hydrate—Process for Producing Aluminum Hydrate. Charles A. Doremus, New York, assignor of one-half to John Sherman Hoyt, Darien, Conn. (U. S. No. 1,215,351; Feb. 13, 1917.)

Cage—Device for Holding Mine Cages. William H. Price, Butte, Mont. (U. S. No. 1,215,409; Feb. 13, 1917.)

Concentration—Apparaus for the Water Concentration of Ores or the Like. William Morley Martin, Redruth, England. (U. S. No. 1,207,967; Dec. 12, 1916.)

Dust—Loading Apparatus for Powdered Materials and the Like. Claude H. Polk, Anaconda, Mont. (U. S. No. 1,211,348; Jan. 2, 1916.)

Dust Separator. Harry A. Thuneman, St. Louis, Mo., assignor to Williams Patent Crusher and Pulverizer Co., St. Louis, Mo. (U. S. No. 1,215,890; Feb. 13, 1917.)

Flotation—Concentration of Sulphide Ores. Henry Lavers, Camberwell, Alfred Henry Piper Lowry, Prahran, and Henry Howard Greenway, Melbourne, Australia, assignors, by mesne assignments, to Minerals Separation American Syndicate (1913) Ltd., London, England. (U. S. No. 1,208,171; Dec. 5, 1916.)

Heat Treatment—Method of Treating Metals and Other Materials by Heat. Jean H. L. De Bats, Zellenople, Penn., assignor of one-third to Alfred G. Zehner, Zellenople, Penn, and one-third to Tensard De Wolf, Pittsburgh, Penn. (U. S. No. 1,216,086; Feb. 13, 1917.)

Hoist—Stop Mechanism for Mine Hoists. Daniel F. Lepley, Connellsville, Penn. (U. S. No. 1,216,143; Feb. 13, 1917.)

Hoist—Safety Device for Hoists. Ludwig Riefstahl, Vienna, Austria-Hungary, assignor to General Electric Co. (U. S. No. 1,216,168; Feb. 13, 1917.)

Iron Metallurgy—Process of Treating Iron Ores. Edward F. Goltra, St. Louis, Mo. (U. S. No. 1,216,109; Feb. 13, 1917.)

Mine Cars—Mounting for Wheels and Axles of Mine Cars. Walter A. Dorsey, Columbus, Ohio, assignor to The Bonney-Floyd Co., Columbus, Ohio. (U. S. No. 1,215,631, 1,215,632; Feb. 13, 1917.)

Mining Machine. George B. Norris, Columbus, Ohio, assignor, by mesne assignments, to The Jeffrey Manufacturing Co. (U. S. No. 1,215,962; Feb. 13, 1917.)

Ore Sampler. Frank B. Pott, Leadville, Colo. (U. S. No. 1,215,988; Feb. 13, 1917.)

Ore Separator. George Hering, Larchmont, N. Y. (U. S. No. 1,216,118; Feb. 13, 1917.)

Placer Mining Machine. Vivian V. Clark, Tucson, Ariz. (U. S. No. 1,215,345; Feb. 13, 1917.)

Quartz Mill. Hart H. Tobener, San Francisco, Calif. (U. S. No. 1,216,185; Feb. 13, 1917.)

Refining—Process of Deoxidizing and Refining Ferrous Metals. Edward H. Schwartz, Chicago, Ill. (U. S. No. 1,215,065; Feb. 6, 1917.)

Retort Apparatus. Edward Fink, Milwaukee, Wis., assignor of one-half to Halleck W. Seaman, Clinton, Iowa. (U. S. No. 1,213,346; 1,213,347; Jan. 23, 1917.)

Rock-Drill. William A. Smith, Denver, Colo., assignor to the Denver Rock Drill Manufacturing Co., Denver, Colo. (U. S. No. 1,214,603; Feb. 6, 1917.)

Rock Drill. Charles H. Haesler, Philadelphia, Penn. (U. S. No. 1,214,542; Feb. 6, 1917.)

Sintering and Smelting. Ore Process and Apparatus. Arthur S. Dwight, New York. (U. S No. 1,215,635, 1,215,636, 1,215,637; Feb. 13, 1916.)

Smelting—Process for Treating Metalliferous Ores. Richard Lewis Lloyd, New York, N. Y., assignor to Dwight & Lloyd Metallurgical Co., New York. (U. S. No. 1,215,672; Feb. 13, 1917.)

Smelting—Feeding Mechanism. Henry J. Stehli, Montclair, N. J., assignor to Dwight & Lloyd Metallurgical Co., New York. (U. S. No. 1,215,739; Feb. 13, 1917.)

Strontium Sulphide—Process of Producing Alkaline Earth-Metal Compounds. Frederick W. Huber and Robert W. Poindexter, Jr., Los Angeles, Calif. (U. S. No. 1,213,375; Jan. 23, 1917.)

Editorial Correspondence

SAN FRANCISCO—Feb. 14

Fatal Mine Accidents in California numbered 41 from Jan. 1, to Dec. 1, 1916, according to Safety Bear Letter No. 6, issued by the mine-safety department of the Industrial Accident Commission. For the same period in 1915 there were 61 fatal accidents. For this improvement much credit is due the mine-safety department and the inspection service. It seems evident that the distribution of Safety Bear letters and the enrolling of miners as members has had a fine effect upon the men who are responsible for accidents in the mines. There are now about 6000 members of the organization who wear Safety Bear badges and read the literature.

Mother Lode Mining Carnival to be held at Sutter Creek, Amador County, on Apr. 14, will be more than a carnival of pleasure for the joyous expression of the youth of the Mother Lode region. It will be a chapter in the modern history of California mining. It will recall the pioneer days and mark the advancement from the crude methods of the early-day mining to the modern appliances adapted to the extraction and treatment of ores. It will impress even the mine owners themselves with the wonderful progress that has been made in reopening idle mines and the fine achievements of the operating mines that have been regular producers for a quarter century or more. This carnival spirit was born a year ago in celebrating the reopening of the Old Eureka or Hetty Green mine. Not that this old mine was more worthy of attention than other idle mines reopened or still idle. But, in the memories of the pioneers of Amador County, there was a closer relation between the Old Eureka and the people of Sutter Creek than existed in any other camp in the county—for the reason that the people of the town had participated more directly in the production of this mine and derived a greater individual benefit from the profits than from any other mine in the district. Alvinza Hayward, a pioneer owner, formed a close-mouthed, one-man corporation; his desire to avoid publicity about his mining enterprises may have been his excuse for giving small heed to the doings of his fellow miners. In addition to the Old Eureka mill hand-stamp mills, mortars, arrastres, grinders of various types situated in cellars and sheds were busy separating the free gold from the quartz; and Pine Street, San Francisco, was busy separating many of these small but prosperous miners from their profits. Sutter Creek had a population of 2000 or 3000 and was wide open to the roof. The good old days when dreams came true, however, passed into history. Hetty Green became the owner of the Old Eureka and a lethargic thrall overtook Sutter Creek. When the announcement of the reopening of the Old Eureka was confirmed by action, the old-timers were stirred as similar announcement of the reopening of no other mine in the district could have stirred them. So they got up a celebration and they had a grand good time. Now the newer generation is going to perpetuate the memory of Hayward and the Old Eureka with another carnival and make it a bigger one and an annual holiday. This year it will be much more elaborate than last year. All the mines on the Mother Lode will participate. The Amador baseball team has invited the Spokane baseball team to visit the carnival and get a walloping; and there will be other sports; probably a first-aid contest; then the youngsters will dance in the evening, and the oldsters will tell yarns.

BUTTE—Feb. 15

Special Tax Question is still to the fore. With less than two weeks left for the present legislature the general public is beginning to doubt the probability of settling this question intelligently or justly within so short a time. The Senate committee, appointed to investigate the question of special taxation, spent five weeks collecting data for its report. Committee finds that the state's population, assumed to be about 700,000, includes 115,000 persons who are dependent on mining; 105,000 persons on railroading, and 400,000 on farming. The aim of the committee in giving these figures evidently was to justify their conclusion that "while the average gross production for each person dependent upon the mining industry is approximately $1300 a year, it is $200 for each person dependent upon farming." Whether the figures be correct or not, "per capita" conditions do not alone furnish a foundation for intelligent method of taxation. Moreover, the facts are that the time allotted for the work was utterly inadequate to collect reliable and complete data; nor is the time remaining sufficient for passing a law that would not only provide the required revenue by special taxation but would at the same time be fair and just to all concerned. It is hoped that the assembly, in the last hours of rush that is sure to occur, will not commit the error of passing a special tax law that will in any way cripple one or the other of the industries of the state or discriminate against any special industry. The house committee found that there are inequalities in taxation and irregularities in assessment, but did not find that the mining industry fails to bear its just and proper proportion of the tax burden. How the immediate needs of the state will be provided for at the last minute by the present assembly, before its adjournment at the end of two weeks, is impossible to predict at present. Protests against a special taxation of the mining industry continue to reach the legislators from all parts of the state. A committee of the recently organized Montana Mining Association has submitted a lengthy communication to the Senate committee in which specific objections to the proposed law were elucidated by figures and arguments similar to those forcibly presented some time ago by the Anaconda company through its vice-president, C. F. Kelley. Whatever may be the ultimate decision of the lawmakers, they will not have the excuse of lack of information regarding the mining industry.

DENVER—Feb. 15

Unwatering Projects at Leadville have had an important bearing on the camp's activities. The Greenback shaft is the latest to be unwatered; this will enable resumption of mining activities in several neighboring mines on Carbonate Hill. On Fryer Hill sinking is proceeding at the Jamie Lee shaft of the Leadville Unit; this work is being pushed to exploit the formations below the upper contact, which has been the only zone heretofore developed in this part of the district; the Harvard shaft will be retained as the central point for draining the large area held by the United States Smelting, Refining and Mining Exploration Co., but the Jamie Lee shaft is to be made the principal opening for mining operations.

"Cascade" Flotation Apparatus, used, last season, at the Mineral Farm mill, near Ouray, attracted considerable attention in the San Juan country. The device was developed by Clifford R. Wilfley of Ouray and was the sole flotation apparatus used at the Mineral Farm mill, making a good recovery on pulp crushed by light gravity stamps to only 24 mesh, without fine grinding. The features of the apparatus are low construction cost and low operating cost, making it adaptable to small plants; it was made almost entirely of lumber by the mill carpenter. The only power required is that for elevating the pulp 15 or 20 ft., and for skimming; the pulp is permitted to cascade by its own fall through a series of aprons and boxes, the plunge into each box giving an effective froth which is skimmed mechanically. A number of these machines are being installed in other Ouray plants.

The Miner's Candlestick has always appeared to have possibilities as a weapon, and in fact miners often carry this utensil as a bodily protection when going to and from night shifts, but it has often proved a treacherous thing to its owner and serious accidents have occurred from time to time. One of these befell a miner at Leadville on Feb. 8th. While going to work, Howard Mulqueen slipped on an icy walk and fell in such a manner as to drive his candlehook into the left lung. His condition is serious. Another accident in the same district occurred Feb. 7 at the Robert Emmet shaft, when a cage parted from its cable and dropped about 550 ft., instantly killing its two occupants, Peter Mattson, 26, and Joseph Trager, 34. Hoisting engineer is said to have been notified hours before that the cable had jumped its sheave and was traveling over the sheave shaft in the headframe; this severe usage is supposed to have resulted in the breaking of the cable.

SALT LAKE CITY—Feb. 16

Activity in Mining, general in this section, is illustrated in the volume of business being done by the Utah Ore Sampling Co. This company on Feb. 12 released 49 cars of ore. Twenty-six cars came from Utah; 12 from California; 9 from Nevada; one from Colorado; and one from Idaho.

Workmen's Compensation Law is being considered by state legislature. The Utah chapter of the American Mining Congress has gathered data and made recommendations with especial reference to the mining industry. The chapter found, through a canvass of the leading mining interests, practically unanimous disposition in favor of workmen's compensation. The following recommendations were made, based on a study of similar measures in other states, and on past experience in this state. The chapter is opposed to monopolistic state insurance compelling all mining companies to insure under a state fund, but would allow all companies to take care of their own insurance if desired, or to insure in regular stock companies. Fair compensation for employees who sustained serious injury is advocated, but slight disability should not be considered of sufficient importance to be made a feature of indemnity. Employeers should be protected against fraud. Fully 90% of accidents occurring in Utah industries do not cause to exceed two weeks' disability, and the chapter favors a waiting period of this length of time, which would minimize imposition. In the matter of compensation the chapter advises that compensation should not be over 50% of wages. In case of fatal accidents, the constitution of the State of Utah prevents making the proposed compensation bill mandatory, but provides that any case resulting in fatal injury can be taken to court if desired.

WALLACE, IDAHO—Feb. 15

Caledonia's 1916 Report contains some striking features, particularly as compared with cost and profits of other lead-silver mines of the Cœur d'Alene district. The gross value of its product was $1,769,669, obtained from 17,464 tons; the value of the lead was $715,301; of silver, $854,544, and of the copper $199,823. The deductions for freight and smelter treatment amounted to $467,556, leaving a net bullion value of $1,302,113. Costs of operation are listed as follows: Mining $2.61 per ton or $120,499; milling 59c. per ton or $22,869; shipping, 22c. per ton or $3981; total cost of operation, $147,350. Net profit for the year was $1,154,762. The Caledonia is the only lead-silver mine in the district in which copper figures as an element of profit. The silver content of the ore is also much higher than for other mines of its class, the report for last year showing the value of the silver produced to be $139,243 more than the lead. The most remarkable feature is the cost of operation as compared with the earnings; the total cost of operation is only about one-ninth of the net profit, that is to say, for every dollar expended in the local operations, the company gained $9 in profit. The cost of freight and treatment was more than three times the cost of the local operations. While it is not shown in the statement, it is known that 35 men is the maximum number employed by the Caledonia in mine and mill. The control of the company is owned by the Bunker Hill & Sullivan company and it is operated under the same management. It may be assumed that, upon the completion of the Bunker Hill & Sullivan smeltery, there will be material reduction in the freight and treatment charges. An unfortunate feature of the Caledonia situation, however, is that its ore reserves are very low and the prospecting campaign has not to date opened any important new orebodies.

ELY, NEV.—Feb. 15

Production Curtailed about 25% during January by coal shortage and weather conditions. Nevada Consolidated was only able to produce about three-fourths of its normal tonnage, or 9000 tons, daily. The continued cold weather seriously interferes with the openpit operations. The water pipe lines (which have to be moved with the shovels and drills) freeze, and it becomes necessary to keep a string of wood fires along the lines; snow and drifts block the railroad tracks and switches; the ore freezes in the cars in transit to the mill and has to be blasted out. At present, however, normal production has been restored. All of the shift and suburban trains are again running; owing to the coal shortage, they were taken off for a time. About 20% of the Nevada Consolidated ore comes from the underground-mining operations of the Ruth mine. Of the ore now coming from the openpits, 75% is primary ore.

Outlying Camps are not so active as a year ago. Owing to the low price for the product, tungsten mining which was very active last year, has dwindled to only one mill running—the Salt Lake Tungstonia, managed by A. R. Sheperd. The Camp Bird company, which held a bond and lease on the old Ward mine, 18 mi. south of Ely, after doing several months work, has given up the bond and quit; leasers, however, are continuing operations and expect soon to be able to ship a car per day to the smelteries at Salt Lake. The old Argus mine near Taylor is again shipping. Leasers, on the old Vulcan mine, 25 mi. southwest of Cherry Creek, in the Hunter district, are shipping lead-silver ore. Some copper ores are being shipped from the Aurum and Muncy Creek district on the east side of the Schell Creek Range; they

are being hauled by auto trucks, around the north end of the range, to Currie, a station on the Nevada Northern R.R., about 70 mi. north of Ely; thus avoiding the Schellbourne Pass, which on account of snow, is now impracticable. A number of miners are taking out ore at the old camp of Hamilton, 45 mi. west of Ely, but on account of the conditions of the roads, they can not ship until next May.

Coppermines Mill is not yet in full commercial operation and the Consolidated Coppermines Co. (Old Giroux) has not yet accepted the 500-ton mill, built by the General Engineering Co., of Salt Lake. Wood is being used as fuel. Two drills are prospecting on its ground, below the railroad track on the flat; some ore is being found. It is announced that more drills will be placed in operation in the spring. Messrs Humphreys, Burgess and Merritt, who have recently financed the operations, have been spending considerable time at the mines. About $700,000 of indebtedness has lately been paid.

ROCHESTER, NEV.—Feb. 15

New Capital has been entering the Rochester district and, with the new discoveries, has strongly augmented the mining activity here. It is expected that the new capital will be an important factor in the future operations of the camp. Lately each month has witnessed a material increase in the demonstrated mineral resources of the big properties, and some of the prospects are being turned into mines, as for example, the Rochester United, which has about 240 acres on the Weaver Cañon slope of Sunflower Hill, adjoining the Rochester Merger and Rochester Mines properties. The district was visited last week by a party of Kansas City men including R. M. Sanford, R. W. Street and Harry Broud, and L. P. Kindred, president of the Farmers' State Bank of Bonner Springs, Kan. They inspected especially the Nenzel-Crown Point workings, where a new vein of sulphide ore had just been cut in the Pitt-Nenzel tunnel, at about 1700 ft. from the portal and 200 ft. beyond the wide vein encountered a month ago, which showed at the point of intersection 25 ft. of rich milling ore. The new vein is 10 ft. wide and the tunnel will be driven ahead about 200 ft. and then a raise of 300 ft. will be put up to connect with the Crown Point tunnel on the American Cañon slope of Nenzel Hill. The raise will cut on their dip several veins already opened by the Crown Point tunnel, and it will also serve as a connection between these workings for the pipe line of the water system which the Nenzel interests will install as soon as possible from American Cañon to the towns of Rochester and Lower Rochester.. Machinery and other equipment for the Rochester Combined Mines Co. are being hauled in from Oreana and will soon be placed in commission at the property, in the Packard section of the district. Development is in progress on several veins, and an energetic campaign of operation will be carried forward.

DULUTH, MINN.—Feb. 16

Cuyuna Range Engineers gave evidence of their patriotism when the 15 who attended a banquet, given by J. C. Barr, of Riverton, at the Kitchi Gammi Club in Duluth, on Feb. 9, all handed in their applications for appointment in the Engineer Officers' Reserve Corps. After the dinner, Lieut.-Col. Edward H. Schulz, U. S. A. reviewed the requirements for this service as outlined in the National Defence Act and pointed out the present deficiency in the engineer reserve. Those who handed in their applications were: J. C. Barr, Frank Hutchinson, William Wearne, B. Magoffin, Jr., L. T. Govin, C. T. Watson, L. C. Davids, A. A. McKay, C. M. Pearce, M. W. Ford, C. D. Peacock, Kenneth Urquhart, A. R. McGuire, U. G. Pearsall, A. F. Victor.

WASHINGTON—Feb. 18

Sage-brush Oil as a flotation agent possesses sufficient promise to cause the Bureau of Mines to undertake additional research in an effort to establish more clearly the exact merits of this oil. The work done with sage-brush oil at the Salt Lake City station of the Bureau has attracted considerable attention. Prof. G. H. Clevenger, of Palo Alto, Calif., a consulting metallurgist of the Bureau of Mines, who has specialized on the use of this oil, recently has been in conference with Dorsey A. Lyon, now superintendent of the Seattle station with regard to lines which will be followed in this work in the future.

Coöperative Research will be conducted by the U. S. Bureau of Mines and several Western schools. Agreements have lately been made with the University of Idaho and with the Oregon Bureau of Mines and Geology. The coöperative agreement with the University of Washington, arrangements for which were completed some time ago, has also been signed. These contracts enable the Bureau of Mines to devote the entire appropriation, allotted to these stations, to research work. The other contracting party in each case furnishes offices, laboratories, equipment and, in addition, contributes some personal service. To carry out its part of the agreement, the Bureau of Mines has appointed E. K. Soper and Robert R. Goodrich as consulting metallurgists who will be in direct charge of the work of the station at Moscow, Idaho. The work at Corvallis, Oregon, will be under the direction of Will H. Coghill, who just has been appointed a consulting metallurgist of the Bureau. He will be assisted by Arthur M. Schwartley, whose title will be assistant metallurgist. An electro-metallurgist at a salary of $2400 has been added to the staff of the mining-experiment station at Seattle which is conducted in coöperation with the University of Washington. This appointment has been given to Francis C. Ryan, formerly with the U. S. Metals Refining Co.

Chalk Shortage is feared by paint manufacturers, judging from inquiries to the U. S. Bureau of Mines as to the supply of chalk. With space in ocean bottoms commanding higher and higher premiums, the imports of chalk are threatened. The chief source of supply is the Dover region of England. Scarcity of labor and probabilities of increasing restrictions on shipping make it imperative that sources of supply in the United States be developed. While the imports of chalk do not exceed 200,000 tons annually, this is the minimum quantity needed by American manufacturers.

TORONTO—Feb. 17

Ungava Exploration is to be undertaken by the Mackenzie & Mann interests. This region is now part of Quebec province. Arrangements have been made with the Marine Department to take a party of geologists by steamer to the Seven Islands from which a long overland trip will be made by dog train.

New Power Line to Kirkland Lake will soon be in operation. Tests of the new transmission line of the Northern Ontario Light and Power Co. from Cobalt to the Kirkland Lake district are now being made, and should the result be satisfactory the line will be put in regular operation next week. The capacity of the plant is 5000 hp., which will supply the needs of the camp for some time to come.

Cyanide Supply for Ontario gold and silver mines was the occasion of considerable worry to mine managers, when, toward the close of the year, the Cassell Co. of Glasgow, who have been furnishing cyanide to the companies, notified their customers that they might be unable to continue the supply. Active efforts were made by Canadian representatives in England to avert the threatened disaster and have proved successful. R. Reid, Ontario government agent in London, has informed the provincial government by cablegram that the Cassell Co. has undertaken to keep up the supply of cyanide for Canadian mines.

The Mining News

ALASKA

MOTHER LODE COPPER MINES CO. (Kennecott)—Company report for year ended Dec. 31, 1916, gives ore reserves as 114,328 tons containing 17,770 tons of copper and 468,074 oz. of silver, an average of about 15% Cu and 4 oz. Ag. Development during year amounted to 2765 ft.

ARIZONA

Cochise County

WILLIE ROSE COPPER MINING CO. (Bowie)—Has made shipment of sulphide ore; planning mill. J. W. Sterling, manager.

HELENS DOME (Bowie)—Small mill at work on complex-ore containing copper, gold, silver and lead. J. H. Jaque, secretary.

Gila County

MIAMI (Miami)—Flotation report for January, required by the court, shows 124,676 tons yielding 1553 tons of concentrates averaging 43.059% Cu. Heads, 1.175%; tails 0.646%.

Mohave County

EMERSON (Chloride)—Tunnel in high-grade ore at 300 ft.

KEYSTONE (Chloride)—North drift on 300-ft. level in high-grade silver ore. Mill expected to start soon.

HIDDEN TREASURE (Chloride)—A 9-ft. vein of milling ore opened in adit about 600 ft. from portal. F. C. Smith, manager.

Pinal County

LAKE SHORE (Casa Grande)—This mine, said to show 600,000 tons of 3% copper ore, sold by Frank M. Leonard to Potter Palmer interests of Chicago, and will be further developed under the title of Atlas Development Co. with E. P. Ryan in charge. H. L. Hollis, 1025 Peoples Gas Bldg., Chicago, consulting engineer.

Yavapai County

UNITED VERDE (Jerome)—Production in 1916 was: Copper, 58,299,000 lb.; silver, 1,030,850 oz.; gold "sales," $546,373. Copper production in 1915 was 45,127,000 lb. Smeltery output now about 6,000,000 lb. monthly.

HULL COPPER (Jerome)—Estate of G. W. Hull secured judgment of $94,096 against this company for development funds advanced.

HUMBOLDT CONSOLIDATED COPPER CO. (Mesa)—This company has taken over the Schill group of eight claims, opened by 300-ft. adit and 200-ft. incline and crosscuts. Further development planned. F. J. Davis, president.

CALIFORNIA

Amador County

CENTRAL EUREKA (Sutter Creek)—Shaft will be deepened to 50 ft. below the 3350 level. Good ore is being extracted from the 2800-level stopes.

TEXAS HILL EXPLORATION CO. (Placerville)—New company formed by Sacramento men, has bonded Gignac and Robinson placer mines. O. A. Ingram, of Eldorado, will be superintendent.

CALIFORNIA CLAY CORPORATION (Ione)—Contemplates installation of firebrick plant to cost about $65,000. Has lease rights on 30,000 acres of clay lands in Arroya Seco grant owned by Ione Coal & Iron Co. This will be the second plant at Ione. A. S. Cunningham is manager.

Butte County

BEAR CANYON (Mooretown)—A. A. Hall reported to have lease; contemplates development preparatory to extracting manganese ore. George Wooley is owner.

ZENITH MINING CO. (Forbestown)—Chrome mining will be resumed as soon as weather permits hauling of ore to Oroville. Deposits near Clipper Mills will also be worked. E. A. Dickey, manager.

Elorado County

MANGANESE CO. OF CALIF. (Kelsey)—Superior court has issued injunction restraining company from development of property recently acquired pending settlement of legal disputes between former owners and the promoter.

Inyo County

STANDARD TUNGSTEN (Bishop)—Mill resumed operation Feb. 5, after shutdown caused by freezing of water supply.

Mariposa County

SCHROEDER (Briceburg)—Development resumed and mine showing up well.

BUENA VISTA (Briceburg)—Formerly known as the Busch mine; recently reopened by W. M. Brice. Large vein reported.

MARIPOSA GRANT (San Francisco)—Reported that Mariposa Commercial & Mining Co. has sold this property to W. J. Morgan Co. and that a first payment has been made. Purchase or option price is not stated. The grant contains about 75 mining claims, some of which have been developed into mines, along the Mother Lode. There are 70 sq.mi. in the grant including mines and agricultural lands. Mining improvements include stamp mills, reservoirs and a hydro-electric plant. The property was originally granted to Gen. John C. Fremont by Governor Alverado in 1847 and is said to have once been mortgaged for $9,000,000 and sold to an English concern for $16,000,000. The Mariposa Commercial & Mining Co. bought it in 1898 for $1,500,000.

Nevada County

PHOENIX (Nevada City)—This gravel mine will be reopened by company organized under laws of Nevada; Judge Bradley V. Sargent, president; Andrew Goering, superintendent.

KENOSHA (Grass Valley)—Mine to be reopened by Lloyd Root, son of former superintendent and part owner. The 400-ft. shaft will be deepened to 1200 ft. Heavier machinery ordered for sinking. Four veins disclosed in old workings at 400-ft. level.

Plumas County

WALKER CONSOLIDATED (Portola)—H. Allread, manager, of Salt Lake, is preparing for development of this copper property. A three-compartment shaft will be sunk immediately.

Shasta County

COPPER DEPOSITS in Stella district, near Whiskeytown and Four Mile House, have been located by I. O. Jillson, former manager of the Gladstone gold mine. Gordon Abrams, Ray Powers and others have also located copper claims in same vicinity. Some activity here several years ago, but low price of copper caused abandonment; there is prospect of actual development now.

SYBIL (French Gulch)—Property being examined by J. R. Davis, of Nevada, who has purchase option on this and other property owned by Accident Gold Mining Co. Mine has shipped some high-grade ore.

Sierra County

NORTH FORK (Forest)—Drifting from bottom of shaft. George F. Stone, manager.

GRAY EAGLE (Downieville)—Development resumed; stamp mill running steadily. Robert Nye in charge.

BUCKEYE (Downieville)—Vein opened carrying free gold and arsenical sulphides. Owens & McKillop developing.

KIRKPATRICK (Mountain House)—Under bond to John Donnelly of San Francisco. Drift in gravel being run northeast toward old rich Magnolia ground. Crew will be doubled.

Tuolumne County

RAWHIDE NO. 2 (Jamestown)—Framework of new machine shops, change room and office completed and framing of timbers for headframe in progress. J. Packard, formerly at the old Rawhide, is superintendent.

MIRIAM MINING CO. (Columbia)—Struck flow of water in east drift on 175-ft. level. New three-stage centrifugal electric pump has flow under control. Drifting being carried on in other part of mine. John M. Jackson, vice-president and superintendent.

MINERAL DEVELOPMENT CO. (Oakland)—Has optioned magnesite deposit owned by Henry Sims of Chinese Camp. Hoist will be installed. Ten men at work and two shifts will be put on immediately. Eugene Schmidt and associates, of San Francisco, interested.

COLORADO

Gilpin County

PEWABIC (Central City)—Rees and associates have secured lease. Mine being drained through the Becky Sharp. Good-grade ore developed, but no work done for some time owing to expense of handling water

EGYPTIAN (Central City)—New plant of machinery being installed on this Quartz Hill property. Old shaft house being repaired, new one to be built. Mine once a producer of high-grade gold ore.

COLORADO-CARR (Central City)—Development work for past two years in virgin ground on old 900- and 1000-ft. levels opened. Gold-silver-copper ore now being shipped. Water now being pumped from 1100-ft. level where further work will be done.

BECKY SHARP (Central City)—Water from this mine and the Federal being drained through diamond-drill hole from Old Town workings at rate of 60 gal. per min. Expected mines to be drained to 500-ft. level soon. Hole driven 550 ft. from 500-ft. level of Old Town mine at cost of $2 per ft. Considerable pyritic ore assaying well in gold developed; shipping to commence as soon as mine drained.

Ouray County

ST. PAUL (Silverton)—Shipments of high-grade gold-copper ore being made by lessees.

ST. LAWRENCE LEASING CO. (Ouray)—Composed of Ouray men; developing group north of St. Paul mine.

SAN ANTONIO (Ouray)—Being overhauled preparatory to resumption of active development. John F. Roper, manager.

GENESSEE (Ironton)—The new flotation plant at this property is nearly completed. Extensive development will soon be started under the management of James M. Hyde.

San Juan County

JANUARY SHIPMENTS from Silverton were as follows: Sunnyside and Gold King, 28 cars each; Iowa-Tiger, 27; Old Green Mountain, 23; Champion, 17; Silver Lake custom mill, 14; Silver Ledge, 13; St. Paul, 6; New Green Mountain, 5; Kittimac, 4; S. D. & G. Leasing Co., Dives Leasing Co., Congress, Ross, Mayflower, 3 cars each; Big Giant Leasing Co., 2; Baggozi, Highland Mary, and Intersection, one car each; miscellaneous small properties, 16; total 201 cars.

LACKAWANNA (Silverton)—Development during past month opened payable lead-copper ore, which is being shipped to Durango. Mine is being reopened by R. E. L. Townsend of Silverton; George Lugg, superintendent.

HIGHLAND MARY (Silverton)—High-grade silver ore opened in this property at head of Cunningham gulch. Under lease to J. H. Slattery, and associates. Ore transported by pack train to the railroad and shipped to Durango plant of American Smelting and Refining Co.

San Miguel County

JANUARY SHIPMENTS from Telluride were as follows: Smuggler-Union, 32 cars of concentrates to Durango and 4 cars to Blende; Tomboy, 54 to Durango and 6 to Blende; Liberty Bell, 13 to Durango; Carruthers lease, one car to Durango; total 110 cars of concentrates.

SMUGGLER-UNION (Telluride)—Blacksmith shop and several timber sheds recently destroyed by fire at Bullion tunnel. All men in mine rescued and no serious accidents resulted from smoke which was drawn into workings. At the Smuggler mills, construction of new 500-ton flotation plant is under way; designed to treat ores from Smuggler, Black Bear and Humboldt properties.

Summit County

MIDDLESEX (Breckenridge)—Tunnel now in 350 ft.; planned to drive 1000 ft. to cut main vein. Shoot of good-grade ore opened recently.

RILLA (Breckenridge)—Shoot of good ore, 3½ ft. wide, opened in raise from west drift on Witch Hazel vein at 1300 ft. from portal. Raise up 40 ft. in ore.

KING SOLOMON (Frisco)—Work will be resumed in main tunnel and development done on No. 2 vein where shoot lead-silver ore opened. Mine has hydraulic power plant.

PIONEER CONSOLIDATED (Breckenridge)—Several veins, not cropping on surface, cut by new lower tunnel; last one assayed well in gold. Good progress made in drifting to open old Jumbo workings. Mill running steadily on ore from Dreadnought tunnel.

Teller County

STRATTONS INDEPENDENCE, LTD., former owners of Independence mine at Victor, now owned by Portland Gold Mining Co., was awarded $11,535 by U. S. District Court in suit against Teller County for excessive taxation.

MODOC CONSOLIDATED MINES CO. (Cripple Creek)—The new Frankenberg shaft will be completed in about 30 days. Raising now in progress from 550-ft. and 675-ft. levels. New shaft will have 10x10-in. Oregon timbers and 4x6-in. guides. New electric hoisting plant will be installed.

ISABELLA (Cripple Creek)—At recent meeting following officers were elected: E. E. Quentin, president; R. N. Carson, vice-president; John W. Brown, secretary-treasurer; and Clark G. Mitchell, manager. Recently shipped 28 tons averaging $92 per ton; mine in better condition than in any recent period.

VINDICATOR (Cripple Creek)—At annual meeting in Denver, Feb. 8, officers elected were: Guilford S. Wood, president (reëlected); Irving T. Snyder, vice-president and general manager; George A. Stahl, secretary; other directors: Adolph F. Zang, Charles Siegel, Jr., A. E. Carlton, Philip A. Zang. Considerable discussion over maintenance of two offices, and consequent duplication of expense. Stated 400,000 tons ore developed. Mill capacity only one-half that expected; changes in equipment to be made.

IDAHO

Owyhee County

DEMMING MINES CO. (Demming, via Murphy)—Properties comprise over 600 acres, with 2000-in. water right on Boulder Creek. At depth of 100 ft., four faces are reported in high-grade ore. M. T. Rowland, of Mampa, vice-president and general manager.

FEDERAL MINING AND SMELTING (Wallace)—This company's operation at North Star mine in Wood River district hampered by lack of miners. Mill getting only 100 tons daily, instead of 150 tons, its capacity. Filter plant to dewater concentrates being built; will contain Dorr thickener and Oliver filter. Railroad facilities at Gimlet improved.

Shoshone County

POLARIS (Wallace)—Last car of 31 tons netted $4000; shipping two or three carloads of silver-copper ore per month. Shaft sunk 100 ft. from main tunnel shows 2½ ft. of high-grade ore; being sunk 100 ft. further, and if showing continues company will drive crosscut tunnel 2500 ft. and gain 800 ft. additional depth.

COPPER KING (Mullan)—Recent strike one of importance. Was made at a vertical depth of more than 1000 ft. below oreshoot opened many years ago near top of hill—approximately 1500 ft. on the dip. Drifting has progressed about 25 ft.; silver-lead ore being sorted for shipment and it is expected that shipments will cover cost of further development. Only about 2 mi. to railroad.

MICHIGAN

Copper

ISLE ROYALE (Houghton)—Daily output of mine reduced about 450 tons by recent flooding of No. 2 shaft. Pumps lowering water some but bailing will be adopted soon.

VICTORIA (Victoria)—This property, being isolated, is still having trouble getting enough men. Sinking has passed the 27th level and drifts started at that point.

HANCOCK CONSOLIDATED (Houghton)—Hancock Consolidated has increased daily rock tonnage to 1000 from No. 1 shaft to the Point Mills plant and tonnage from Quincy No. 7 to Quincy mill is maintained at normal. Copper contents higher than from previous ore.

COPPER RANGE (Painesdale)—Production for 1916 from these mines averaged 33 lb. of copper per ton—probably highest average for 1916 of any large producer in district; company's Champion mine averaged over 35 lb. per ton. Company uses 30 electric locomotives.

CALUMET & HECLA (Calumet)—January copper production of this company and subsidiaries was as follows: C. & H., 6,576,868 lb.; Ahmeek, 2,411,329; Allouez, 861,413; Centennial, 163,841; Isle Royale, 1,172,149; La Salle, 130,761; Osceola, 1,513,942; Superior, 318,798; Tamarack, 585,328; White Pine, 368,697.

Iron

ATHENS (Negaunee)—Order placed for large geared pump. Will lift water 2600 ft. Greatest single lift of any pump in district. Pump at the Newport in Ironwood, is lifting 2200 ft.; the record-holder at present.

PLYMOUTH (Verona)—About 2,000,000 yd. of material will be moved this season. Shovel equipment will consist of one Class 225 Bucyrus—largest built—one 103 C and 35 B Bucyrus. For stripping, a Bucyrus Class 24 electrically operated dragline excavator will be used. C. A. Meyers, superintendent.

MISSOURI

MID-NATION IRON PRODUCTS CO. (Williamsville)—This company, organized by Earl A. Clemons of Clemons Construction Co., of Chicago, controls 24,500 acres near Williamsville in Wayne County and 800 acres in Butler County. Iron-mining operations to be undertaken and possibly smelting will be done near St. Louis.

BUTLER IRON CO. (Poplar Bluff)—Controls 10,000 acres in Butler County. Openpit mining will be done and a 50-ton blast furnace and charcoal plant erected. Directors include: W. W. Mechling, president; M. H. Cutter and C. E. Temple, vice-presidents; H. F. Landeck, treasurer; J. A. Massen, secretary; B. F. Baker, W. E. Orthwein, E. P. Sedgewick and C. H. Wheeler.

Joplin Zinc-Lead District

FLANNERY (Sarcoxie)—New mill, to replace one burned Dec. 2, ready for operation.

LIGHTBURN (Joplin)—Good drill strike on lease 2½ mi. east of Picher, Okla.; shows 17 ft. of 15% ore at 129-ft. level.

RICHARDS (Quapaw, Okla.)—Will erect new mill on lease 1 mi. northwest of Quapaw; 14 good drill holes obtained. John D. Richards, Tulsa, manager.

M. M. & B. (Duenweg)—Erected small mill for silicate mine in new territory southeast of Scotland, Mo. Making 40 tons weekly from 35-ft. level. First lease owned by Playter Bros., Joplin.

KING DAVID (Joplin)—Bought 150-ton McClintock mill and moving it from Cave Springs to Chitwood. To be ready April 15. Two shafts in ore on lease. Playter Bros., Joplin, owners.

ATHLETIC (Webb City)—Now getting about 400 tons of ore daily from San Gabriel field shaft, about 2000 ft. from mill; gasoline locomotive used for tramming. Recently installed electric hoist and 5000-lb. skips; 112-hp. motor used; capable of making 400 round trips in 8 hr. but ground is not yet sufficiently opened to require this capacity. Charles T. Orr, general manager.

Northern Arkansas

EVERTON MINING AND DEVELOPMENT (Everton)—Building 150-ton mill for Big Joe zinc-carbonate mine. Hoist and drills operated from direct-driven air compressor. Two oil engines, one 80-hp. Muncie and one 50-hp. Chicago Pneumatic. Garford truck will be used to haul concentrates 3 mi. to Everton. Prospecting with No. 3 Keystone drill. Joseph Migliore, 71 W. 23rd St., New York, president; J. Hamilton Mobley, general manager.

MONTANA

Beaverhead County

OIL DEVELOPMENT, according to reliable information, is being done by the following companies in the Beaverhead fields: National Oil, Beaverhead-Bitter Root Oil and Gas, and Beaverhead-Alberta Oil and Gas Co., all of which are now drilling; the Dillon Oil Co., financed by Butte capital, has not yet started drilling; in addition there are the Ainslee group and the Red Rock and Black Butte claims, comprising several thousand acres of oil land. Drill of National Oil is down about 1000 ft. and there is a thin film of crude oil on surface. Beaverhead-Alberta is down about 800 ft. On the Red Rock and Black Rock claims, oil shale is found which upon distillation is said to yield crude oil having a paraffin base and high gasoline content. In the Muddy Creek district, more than 12,000 acres of shale-bearing ground have been located. The districts included in the Beaverhead County oil fields are the Muddy, Little Sheep Creek, Dell and Smallhorn, all within easy distance of railroads.

BANNACK GOLD MINING (Bannack)—At annual meeting, Jan. 30, stockholders authorized bond issue of $125,000 to pay indebtedness and carry on general mining work. Report shows mill completed; ready for operation as soon as electric power is available. Before another winter company expects to have auxiliary steam plant to furnish power independent of the hydro-

electric plant, now out of commission due to freezing of stream.

Jefferson County

BOSTON & MONTANA DEVELOPMENT CO. (Butte)—With completion of 2700-ft. tunnel in company's property in the Elkhorn district, crosscutting to the vein at a point 2000 ft. from mouth of tunnel has been started. Contract for 500-ton mill has been let. Work started in Big Horn Cañon on the Butte, Wisdom & Pacific Ry.

Granite County

OLYMPIA MINING (Princeton)—Annual report states development work, carried on for last 18 months, opened body of commercial ore. Properties in Phillipsburg district; connected by good 5-mi. wagon road with Northern Pacific Ry. tracks.

Madison County

ALAMEDA AND WAKOOSTA (Virginia City)—George Westinghouse, Jr., of Pittsburgh, Penn., has recently become owner of these mines, just west of city limits. Properties are known to contain bodies of sulphide ore in depth, having yielded in the past considerable gold from surface down to 300-ft. level. Expected that operations will be resumed in the spring.

Silver Bow County

DAVIS-DALY (Butte)—New 1000-ft. shaft authorized by directors on Hibernia claim, near Anaconda's Nettie mine. Management suggested four new prospecting shafts. Company hoisting about 250 tons daily.

MINES OPERATING CO. (Butte)—After short shutdown caused by delay in acid shipments, operations have been resumed at Butte-Duluth property. More than 50 men are at work at mine and mill and output has been increased to 250 tons a day. Arrangements with Bullwhacker company nearing consummation.

NEVADA

Clark County

RAND MINING (Searchlight)—This Eldorado Cañon property will add a flotation department to its mill. Robert Dunbar, manager.

Humboldt County

HELEN-BETTY MINES CO. (Seven Troughs)—This company will reopen old Mazuma Hills and Extension mines; unwatering will soon be started. Darby mill also optioned. F. E. G. Berry, manager.

Nye County

TONOPAH ORE PRODUCTION for week of Feb. 10 was 9261 tons of an estimated value of $166,698, as compared with 10,094 during previous week. The producers were: Tonopah Belmont, 2863 tons; Tonopah Mining, 1900; Tonopah Extension, 2380; Jim Butler, 850; West End, 429; Rescue, 190; Halifax, 214; Montana, 352; MacNamara, 53; Midway, 30 tons.

Storey County

ANDES (Virginia)—Saved 85 cars, averaging $11.60, from 350 level stope.

CON. VIRGINIA (Virginia)—Southwest drift 2700 level advanced 44 ft. through quartz and clay.

JACKET-CROWN POINT (Gold Hill)—Extracted 154 cars while cleaning out and repairing crosscut.

MEXICAN (Virginia)—Continued work on 2300 level and Ophir south drift, 2700 level. Old main south drift cleaned out and repaired on 2300 level and jointly with Union advanced west crosscut on north boundary total distance 72 ft.

COMSTOCK PUMPING ASSOCIATION (Virginia)—At Ophir and Mexican winze, both sinking pumps working satisfactorily; water on Feb. 10 180 ft. below 2700 level; on Feb. 14 2900 level reached.

UNION CON. (Virginia)—Conditions generally improved; 53 tons averaging $22.94 extracted from 2500 level. Vein has turned to southwest and joined the north and south vein; 1 ft. wide sampling $24 per ton. Prospecting on this level from No. 2 crosscut has given encouraging results. In southwest drift 40 tons of ore averaged $15.54.

White Pine County

ELY CONSOLIDATED (Ely)—Pumping water out of Zack shaft; also retimbering first 100 ft. of American shaft. William Campbell, superintendent.

ARGUS (Ely)—This old producer near Taylor, east of the Ward mine, is again being operated, shipping ore to Salt Lake; H. C. McCulloch, manager.

NEW MEXICO

Grant County

SOCORRO (Mogollon)—Production from Pacific mine being increased; good ore showing on 500 level.

MOGOLLON MINES CO. (Mogollon)—Has completed ore pockets, timbering and piping to 900-ft. level and is drifting east at rate of 6 ft. per day.

Beaver County

MAJESTIC MINES (Milford)—January shipments from Old Hickory mine 10 cars; ore from large opencut. Company's Hoosier Boy mine operating. Drifting being done on 800, where small stringers of ore are appearing in the face.

Juab County

TINTIC SHIPMENTS for week ended Feb. 9 amounted to 200 cars.

IRON KING (Eureka)—Assessment levied with view to resuming in spring.

EUREKA MINES (Eureka)—Bottom of winze down 7 ft. from 1200 level in ore. Operated through Gemini shaft, under same management.

CHIEF CONSOLIDATED (Eureka)—Report for 1916 shows receipts of $1,601,903; disbursements of $1,124,607, leaving cash on hand of $477,295. Company's most successful year. Dividends of $576,710 to date. There were shipped 83,606 tons of ore carrying 8331 oz. gold; 1,739,004 oz. silver; 18,356,937 lb. lead; 1795 lb. copper; and 790,825 lb. zinc. Work done from 600 to 1800 levels amounted to 25,844 ft. Company owns 3250 acres unpatented ground and 1345 acres patented. During year 600 acres acquired and paid for, covering property of Homansville Mining, Baltimore Consolidated, Little Edgar and Duprezin, giving company continuous ownership of ground from the mine for a distance of 3½ mi.

Salt Lake City

HOWELL (Salt Lake)—New tunnel, under old surface workings, in about 300 ft. Property adjoins Cardiff on west and north.

MICHIGAN-UTAH (Alta)—Two new directors—C. A. Gillette and F. B. Cook—elected to take place of F. W. Price and Duncan MacVichie, resigned. N. W. Haire president. This year 30 cars of ore have been shipped, and 800 tons accumulated at Tanner's Flat and 200 at Wasatch. Development of ore in Copper Prince tunnel opened in November, continues. Employing 85 men.

Summit County

IOWA COPPER (Park City)—New compressor installed and 100 ft. of tunnel retimbered.

THREE KINGS (Park City)—Winze from 500 level down 170 ft.; stringers of silver-lead ore showing.

KEYSTONE (Park City)—Crosscut from Judge tunnel progressing rapidly with three shifts. George Krueger, of Judge Mining and Smelting, foreman.

SILVER KING CONSOLIDATED (Park City)—First-class ore coming from No. 2 stope (main working). Mill treating 50 tons of second-class ore daily.

JUDGE MINING AND SMELTING (Park City)—Test runs made at new electrolytic zinc plant. Few minor adjustments and changes being made. Plant to be running soon.

ONTARIO (Park City)—Shaft retimbered to 50 level. Within next two weeks unwatering from 1500 to 1700 expected to be under way, after which mining will be resumed on these levels.

Utah County

AMERICAN FORK CANON is unusually active for so early in the season, and with the coming of more favorable weather this promises to increase. At the Miller Hill, a blower has been installed to take care of gas encountered in tunnel now in 1300 ft.; expect to reach the fissure within 700 or 800 ft. Among the active properties are the Earl-Eagle, Dutchman, Belerophon, Pacific, etc. The Pacific shipped 21 cars of ore during 1916, smelter returns from which were $49,999, the company receiving $8636 from this as royalties, and paying to stockholders a dividend of $8000.

WASHINGTON

Ferry County

KNOB HILL (Republic)—About 7000 tons shipped last year. Further development of Mud Lake claim planned; tunnel to be extended and shaft sunk 100 ft. below tunnel. John W. Lloyd has resumed charge of operations.

WISCONSIN

Zinc-Lead District

TIFFANY (Platteville)—New 200-ton concentrating mill at Potosi placed in operation.

NEW ROSE (Platteville)—This new company now producing zinc ore on the Weigle land.

FIELD MINING AND MILLING (Scales Mound, Ill.)—This company has taken over Little Corporal mine at Galena.

WISCONSIN (Platteville)—Driving 700 ft. north to connect the Winskell mine with newly discovered "range."

MINERAL POINT (Galena, Ill.)—Constructing buildings, concreting shaft and preparing to erect new concentrating mill at the Hoskins (on Meloy tract) at New Diggings, Wis.; owned in fee by company.

VINEGAR HILL (Platteville)—New Meloy mill, at New Diggings, placed in operation. Foundations laid for 200-ton Jefferson mill at Hazel Green; headframe in course of construction; shaft is to be sunk 240 ft.; a drainage tunnel will be driven 750 ft. into hillside to cut off heavy water flow. New shaft being sunk for "drybone" on Robinson land adjoining the Meloy lease at New Diggings. The Hodge, at Platteville, an abandoned property reöpened by this company, is making weekly output of 160 tons of zinc concentrates.

CANADA

British Columbia

GALENA FARM (Silverton)—Milling ore, averaging 10 ft. in width and assaying 8% lead and 16% zinc, opened on one of the lowest levels.

PACIFIC SYNDICATE, LTD. (Princeton)—One of the largest deals in British Columbia mining history was consummated through W. R. Heineman by the taking over of the Voigt properties by New York interests. The bonding price is announced at $3,000,000. In addition to the Voigt properties, the same interests have bonded group of 22 claims adjoining the Britannia mine on Howe Sound. At the Voigt camp, the developments are expected to include large concentrating mill, power plant and transportation facilities. The camp is about 3 mi. north of the Copper Mountain property of the British Columbia Copper Co., which is now reported to have 11,000,000 tons of 1.75% copper ore.

Ontario

NIGHT HAWK LAKE (Porcupine)—Installing small plant.

KEORA (Porcupine)—Arrangements made to finance company.

NIPISSING (Cobalt)—Production for January estimated at $282,698.

INSPIRATION (Porcupine)—Will stop diamond drilling; nothing of importance was cut.

LA ROSE (Cobalt)—New high-grade vein opened in old workings.

McINTYRE (Schumacher)—Mill capacity will be raised to 600 tons a day within the next month.

KIRKLAND LAKE GOLD (Kirkland Lake)—Cut the vein at 500-ft. level where it shows good width.

NEWRAY (Porcupine)—Quartz vein, 4 ft. wide, showing visible gold, struck in diamond drilling at a depth of 104 ft.

CROWN RESERVE (Cobalt)—Vein recently found at 800-ft. level is stated to be 20 in. wide, of which 4 in. is high grade.

APEX (Cobalt)—A 5-ft. vein, highly mineralized, encountered in diamond-drill hole at 900 ft.; in contact between basalt and Keewatin.

SYLVANITE (Kirkland Lake)—A 5-drill electric-driven compressor and a hoist have been installed. Development will be started as soon as power is obtained.

DOME LAKE (Porcupine)—Annual report shows deficit of $92,787; estimates of ore reserves not substantiated. Mill heads for the last two or three months said to have run under $3 per ton.

BEAVER (Cobalt)—At the lower contact, intercepted third vein of high-grade ore. The three veins are within 14 ft. Discovery is of extreme importance to the Beaver and to the camp as a whole.

HOLLINGER (Timmins)—On account of shortage of labor, unable to earn the dividend. Increased mill capacity will result in a drop in grade of ore; doubtful if sufficient men can be obtained to supply larger mill.

VACUUM GAS AND OIL (Thamesville)—It has been officially stated that additional acreage has been secured giving control of a very extensive field. Boundary wells have been sunk which show that the oil pool is at least two miles in length by ⅝ mi. in width. There are 15 producing wells equipped for pumping. Since Oct. 24, over 2700 barrels have been shipped.

Yukon Territory

WHITEHORSE SHIPMENTS have been stimulated by high price of copper. The Grafter mine is shipping from 600 to 1000 tons per month; the old Pueblo now known as the Yukon has an output of about 600 tons monthly; the Copper King is averaging 300 tons per month; the War Eagle 450 tons and the Anaconda 100 tons monthly.

MEXICO

FORFEITURE OF UNWORKED MINES owned by foreigners in Mexico is to proceed, according to dispatch from Ambassador Fletcher, unless mine owners file statements showing cause of idleness and requesting extension of time from Feb. 14.

CHILE

CHILE EXPLORATION (Chuquicamata)—Copper output in December was 3,636,000 lb., and for January, 7,756,000 lb. Neither of these figures is a true indication of the company's operations, as in December there was a large quantity of copper on hand as cathodes; only copper in the form of ingots or wirebars is included in the monthly production figure. In January, a great part of these December cathodes were turned into ingots and included in the January production; even at the end of January there was still on hand an abnormal amount of copper in the shape of cathodes. Rate of copper extraction during December and January was actually a little over 6,000,000 lb. per month.

NORWAY

PYRITES EMBARGO established with reference to Germany, in exchange for lifting of restrictions on shipment of coal from Great Britain.

The Market Report

Metal Markets

SILVER AND STERLING EXCHANGE

Feb.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Feb.	Sterling, Exchange	Silver New York, Cents	Silver London, Pence
15	4.7544	78⅜	38½	19	4.7544	78⅜	38½
16	4.7538	78⅜	38¼	20	4.7544	78¼	38
17	4.7538	78⅜	38⅛	21	4.7540	77⅞	37¾

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Feb.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
	31½		8½	8½	9⅜
15	@32⅜	51	@9	@9	@10¼
	31½		8½	8½	10
16	@32⅜	49½	@9	@9	@10¼
	31½		8½	8½	10
17	@32⅜	49½	@9	@9	@10¼
	32		8½	8½	10
19	@33	49	@9	@9	@10¼
	32½		8½	8½	10⅜
20	@33⅜	48½	@9	@9	@10⅜
	32⅜		8½	8½	10⅜
21	@33½	49	@9	@9	@10⅜

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies; and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold on "regular terms" (r.t.), including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Feb.	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
15	140	136	149	199½	198¾	30½	47
16	140	136	149	198	197½	30½	47
17	....	....	....	....	....	....	....
19	140	136	149	195½	195¼	30½	47
20	139	136½	150	194½	194½	30½	47
21	139	136	150	195¼	195¼	30½	47

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 643c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅜c.

NEW YORK—Feb. 21

With the exception of tin, all of the metals were dull, but very strong during the last week. The sold-out condition of the producers of copper and lead, and the freight congestion continued to be major factors. Consumers appreciating the situation in the main refrained from attempting to buy.

Due to a delay in the cable service, the report, in the "Journal" of Feb. 17, of London, metal prices for Feb. 14, was incomplete. The correct figures, according to latest reports, are as follows: Copper, standard spot, £140; futures, 136; electrolytic, 149. Tin, spot, £199½; futures, 199. Lead, £30½. Zinc, £47.

Copper, Tin, Lead and Zinc

Copper—There was some more of the nibbling for July copper, the beginning of which was reported last week. Producers are desirous of selling for July delivery, which they can supply, and they met the demand of some of their customers for June copper by coupling July with it. The bulk of the transactions last week were for June-July delivery. However, the aggregate was not large, being apparently about the same as in the previous week. On early deliveries fancy prices were realized. In the latter part of the week, February was quoted at 37c., March, at 35@36c., April, at 34@35c., and May, at about 34c. Such business as was done for those deliveries was wholly by brokers and the sum total of it for all months up to June probably amounted to only a few hundred thousand pounds.

Exports from Baltimore included 82.5 tons of brass blanks and 472 tons of copper to France.

Copper Sheets—Base price for copper sheets continues unchanged. The quotation is 42c. for hot rolled and 43c. for cold rolled. Wire is quoted on a base of 37c. f.o.b. mill.

Tin—This market having recovered from the effects of the panicky buying in the early part of the month, continued to sag away. Very little business was done during the last week, even at the reduced prices.

Lead—In spite of the reports in the newspapers, which were quite misleading, the business in lead during the last week was very small. The aggregate reported by the principal producers was only about 600 tons. For lead on the spot all kinds of fancy prices were reported. We heard gossip of 10, 10½ and even 11½c., but this was merely for carload business, done by brokers, which in the aggregate did not amount to much. A few distressed buyers might be found, willing to pay anything. The business done by producers was for March, March-April and April shipment. There were fairly free sellers for April, and even March-April shipment, at 9c. The A. S. & R. Co. maintained its price at 8½c. on which basis it made its contractual deliveries and booked some business with its regular customers. The policy of this company, as well as that of other large producers, is discussed editorially in this issue. In the interior markets—Pittsburgh district—sales were reported made at 9¼@9¾c., with last sales at 9¾c., March delivery. Premiums were reported realized in the St. Louis market. The lead market of the week was in a state of great confusion, although the turnover was very light. We aim in our quotations to reflect the average market, but in the circumstances of the last week we can do so but nominally.

The Hercules mine is reported as having sold a considerable tonnage of lead concentrates to the Consolidated Mining and Smelting Co., of Canada, for monthly delivery at Trail. This will tend to relieve our market of some of the Canadian demand for pig lead, although, of course, the results will not be felt immediately.

Two producers have given us the exact quantity of their lead in transit between the Mississippi River and Atlantic Seaboard. In each case it was just three times the normal amount.

Zinc—This market was also very dull, but as in the previous week, it was sentimentally very strong. The bulk of the business reported was for February and February-March delivery. There is plenty of near-by spelter available. Spot spelter in New York, like lead, fetched a large premium, but this was for carload business not amounting to much. We heard of a carload sold at 12c.

Zinc Sheets—No change has been made in the market price of zinc sheets. Quotation is $21 per 100 lb., f.o.b. Peru, less 8% discount.

Other Metals

Antimony—The market is again practically bare; the relief afforded by last week's 300-ton arrival having extended over only two or three days. Sales are being made at 32@34c., but the lots are very small, only a matter of 200 or 300 lb. On the other hand, we had report of other sales at 29@29½c. No one is buying unless forced to, and then in minimum quantity necessary to cover needs. We quote the market at 32c., which, however, is purely nominal as in the confused conditions it is impossible to judge prices definitely.

Aluminum—The aluminum market continues quiet, with buyers scarce. Nominal quotations are at 58@60c. per lb. for No. 1 ingots, New York.

Nickel—No change appears in nickel quotations. Price remains at 45@50c. per lb., with electrolytic commanding an additional 5c.

Quicksilver—Market has become steady with good demand after disturbed condition last week due to scarcity, during which small lots were sold at $140@150. On Feb. 20 a round lot was reported sold by a producer at $135 and we quote the market at that price. San Francisco reports, by telegraph, $130, quiet.

Gold, Silver and Platinum

Gold—Recent shipment of $25,000,000 gold from Canada consisted of Petrograd gold brought to Ottawa by way of Vancouver. Other shipments have been made prior to this, and represent amounts contributed by Imperial Bank of Russia which has pooled its gold holdings in coöperation with Bank of England and Bank of France for purpose of forwarding gold to this country and stabilizing exchange.

The sub-treasury has transferred to San Francisco gold to the amount of $2,500,000 on account of an equal amount of gold to be exported to Japan. Gold coin to the amount of $100,000 has been withdrawn from the New York subtreasury for export to South America.

Silver—Owing to weakness in the China Exchange silver has declined to 37¾d. today. Buying for the usual orders which have been in force some time still continues. About 11,000,000 oz. were shipped from San Francisco to the East from August, 1916, to the end of the year as per the figures of the collector of that port.

British government buying of late for minting purposes and the probability of the French government also entering the market for additional supplies for the same purpose were the primary causes in forcing silver up to 79c. an ounce this week.

The difficulty in ocean transportation has become an all-important factor in this metal. Just how much may be at the present time on its way to England and how much more awaits shipment either from Montreal or New York cannot be ascertained, but silver authorities indicate it to be a considerable amount.

Mexican dollars at New York, Feb. 15, 60⅞@63⅞c.; 16, 60⅞@63⅞c.; 17, 60⅞@63⅞c.; 19, 60⅞@63⅞c.; 20, 60⅝@63⅝c.; 21, 60⅜@63⅜c.

Platinum—Quoted at $105, unchanged from last week.

Paladium—Quoted at $92.50 per oz.

Zinc and Lead Ore Markets

Platteville, Wis., Feb. 17—Blende, basis 60% Zn, $88 for premium ore down to $85 for medium grade. Lead ore, basis 80% Pb, $100 per ton. Shipments for the week are 2329 tons of zinc ore, 76 tons of lead ore, and 329 tons of sulphur ore. For the year to date the figures are: 17,762 tons of zinc ore, 478 tons of lead ore, and 3189 tons of sulphur ore. Shipped during week to separating plants, 3392 tons of zinc ore.

Joplin, Mo., Feb. 17—Blende, basis 60% Zn, $80@90. Fancy ores realize a premium and low-grade ores sell at a discount. Calamine, basis 40% Zn, $50 to $55. Average selling price, all grades of zinc ore, $83.29 per ton.

Lead ore, basis 80% Pb, $108@122.50. Average selling price, all grades of lead $106.67 per ton.

Shipments for the week: Blende, 7435 tons; calamine 778 tons; lead 1295 tons. Value, all ores the week, $821,540.

One car-lot of extra fancy ore with no trace of lead, sold this week for $100 per ton.

The freight embargo, coming on Thursday, prevented a $5 to $10 advance in ore prices, which buyers admit they expected. Several holders of large tonnage fearing the effect of the embargo, asked for bids and sold just at a moment that broke what was conceded to be an unusually strong market. The power situation grows, if possible, worse from week to week. No electricity and no gas.

Other Ores

Antimony Ore—Held at $2.50 per unit, but no business reported at that figure.

Tungsten Ore—We quote this market at $16@17 per unit.

Charles Hardy makes the following interesting report under date of Feb. 20: "The tungsten market has been quite interesting during the past week. On account of the freight congestion, material actually in the East has been sold at a premium. Scheelite which is just now very much in demand has again realized

$17, and further quantities could be sold at that figure if anything of a desirable nature can be found east of Chicago. Ferberite, which is always in demand, has realized $18 a unit. Wolframite, however, of which there was at one time considerable stocks, had to be sold at a concession in the New York market, but at no time did the price go below $16. As a matter of fact, most sales were made well above that figure. The foreign market has again taken a quantity and the stocks in New York have been so much reduced that they would supply the normal requirement for only one month. If, however, the demand from abroad continues at the same rate as at present, it is very doubtful whether the stocks here will last longer than a fortnight to three weeks at the best. The freight congestion in the whole country has been a great help to stimulate the tungsten market and our home buyers have been taking quite a quantity of the New York stocks.

Molybdenum Ore—Charles Hardy reports as follows: "From all quarters complaints are made that contracts entered into for the supply of molybdenite have been very badly fulfilled. In addition to the scarcity of the ore, the freight congestion has played havoc with the market.

Iron Trade Review

NEW YORK—Feb. 21

With the worst railroad tangle known, says "Iron Age," and scores of men from the largest manufacturing concerns trying to ferret out cars containing raw materials for their works, it is not surprising that a spot market, with numerous higher prices, has developed in steel as well as in iron. Tightness of order books has not allowed for a big volume of such business and the condition seems not likely of long duration.

PITTSBURGH—Feb. 20

The very bad traffic condition has been the chief factor in the iron and steel situation, causing reduced deliveries and greater pressure for material. Last week's coke shipments were about one-half the actual requirements, being the smallest since the depression. Pig iron and coal have been very scarce. Steel production has been at a reduced rate, through lack of material and lack of adequate shipping facilities. As an extreme instance, the Continental and Pennsylvania works in Pittsburgh and the Lorain pipe mill of the National Tube Co. are idle from lack of coal, while four of the five Lorain blast furnaces are banked from lack of coke.

Yesterday and today traffic conditions are measurably improved and the present mild weather promises further improvement. Spot furnace coke reached record high price Saturday but is easier today. Car supplies at steel mills are better but are still far from adequate.

There is increased inquiry for steel products for forward delivery, attributed to buyers concluding that war preparations by the United States will make steel scarcer then than was expected. Standard iron and steel pipe, line pipe and oil country goods have advanced about $4 a ton. The new basing discount on steel pipe is 62% off, making the price double that at the low point at the end of 1914. Wire nails are double price while most other steel products are much more than double price. Steel hoops are higher at 4@4.50c. and black sheets are now 4.75c. minimum, or $5 a ton advance.

While steel mill bookings are at a rate less than half of that in November, the accumulation of business on books is not materially decreasing and operations throughout the year are expected to be as full as traffic conditions will permit.

Pig Iron—The scarcity of foundry iron has increased, with production decreased by the coke shortage, and higher prices are paid, $35@36, valley, but buying is confined to these prompt deliveries. There is more demand for prompt basic but the price has not advanced, several sales having been made at $30, valley. Prompt bessemer is scarcer and is held at $36, valley. We quote foundry and malleable for prompt shipment, there being no forward market, at $35@36, bessemer at $35@36 and basic at $30, all f.o.b. valley, delivered Pittsburgh being 95c. higher. Southern iron is stiffer at $25, Birmingham, for prompt and $24 for second half, freight to Pittsburgh being $4.55. The last important sales of valley foundry were at $30, valley.

Steel—A sale of 7500 tons of ordinary open-hearth billets, delivery to July 1, has been made at $65, f.o.b. Pittsburgh district mill, and the market for billets and sheet bars is quotable strong at this figure, there being only occasional offerings.

Ferroalloys

Ferromanganese—A distinct shortage in early deliveries has developed through inquiry by smaller users, who do not buy ahead, the large consumers being well covered. Domestic is $275@300 for prompt, $250 for second quarter and $200 for second half, delivered east of the Mississippi, while imported has been advanced from $164 to $185, seaboard, for indefinite delivery.

Ferrotungsten—Quoted at $2 and business reported done at that figure.

STOCK QUOTATIONS

N. Y. EXCH.†	Feb. 20
Alaska Gold M.	8⅛
Alaska Juneau	7⅛
Am.Sm.&Ref.,com.	101½
Am. Sm. & Ref., pf.	112
Am. Sm. Sec., pf. A	99
Am. Sm. Sec., pf. B.	95½
Am. Zinc	39
Am. Zinc, pf.	68
Anaconda	79½
Batopilas Min.	1⅛
Bethlehem Steel	140
Bethlehem Steel, pf.	120
Butte & Superior	47⅞
Chile Cop.	23⅛
Chino	56
Colo.Fuel & Iron	48⅝
Crucible Steel	67⅛
Dome Mines	20⅛
Federal M. & S.	15
Federal M. & S., pf.	44⅛
Great Nor., ore ctf.	33⅛
Greene Cananea	43
Homestake	126
Inspiration Con.	58⅛
International Nickel	41⅛
Kennecott	45⅛
Lackawanna Steel	80
Miami Copper	39
Nat'l Lead, com.	58⅛
National Lead, pf.	110
Nev. Consol.	25⅛
Ontario Min.	6
Quicksilver	2⅛
Quicksilver, pf.	2
Ray Con.	27⅛
RepublicI.&S.,com.	79
Republic I. & S. pf.	101⅛
Sloss-Sheffield	62⅛
Tennessee C. & C.	16
U. S. Steel, com.	109⅛
U. S. Steel, pf.	118⅛
Utah Copper	111⅛
Va. Iron C. & C.	56

N. Y. CURB†	Feb. 20
Buffalo Mines	1⅛
Butte & N. Y.	1
Butte C. & Z.	9⅛
Caledonia	.60
Can. Cop. Corpn.	1
Carlisle	5⅛
Cashboy	.06
Cerro de Pasco	40
Con. Ariz. Sm.	2⅛
Con. Coppermines	3⅛
Con. Nev.-Utah	
First Nat. Cop.	3
Florence	‡.70
Goldfield Con.	.63
Goldfield Merger	.07⅛
Granite	⅜
Hecla Min.	7 11/16
Howe Sound	6⅛
Jerome Verde	1⅛
Joplin Ore & Spel.	‡.32
Kerr Lake	4 13/16
Magma	51⅛
Majestic	⅛
McKinley-Dar-Sa.	.52
Mother Lode	.40
Nevada Hills	.21
N. Y. & Hond.	15
Nipissing Mines	8⅛
Ohio Cop.	1⅛
Ray Hercules	4⅛
Rochester Mines	.60
St. Joseph Lead	19
Standard S. L.	.75
Stewart	⅜
Success	.43
Tonopah	6⅛
Tonopah Ex.	4⅛
Tribullion	.37½
Troy Arizona	.55
United Verde Ext.	39½
United Zinc	3⅛
White Knob, pf.	1⅛
White Oaks	2
Yukon Gold	2

SAN FRAN.*	Feb. 20
Alta	.04
Andes	.25
Best & Belcher	.03
Bullion	.02
Caledonia	.19
Challenge Con.	.04
Confidence	.06
Con. Virginia	.08
Gould & Curry	.02
Hale & Norcross	.04
Jacket-Cr. Pt.	04
Mexican	.13
Occidental	.65
Ophir	.04
Overman	.04
Savage	.05
Seg Belcher	.02
Sierra Nevada	.10
Union Con.	.43
Utah Con.	.01
Belmont	4.40
Jim Butler	.81
MacNamara	.08
Midway	.17
Mont.-Tonopah	.20
North Star	.16
Rescue Eula	.25
West End Con.	.65
Atlanta	.13
Booth	.09
Comb. Frac	.04
D'field B.B.	.02
D'field Daisy	.03
Florence	.22
Jumbo Extension	.27
Kewanas	.17
Round Mountain	.42
Silver Pick	.15
Argo	.05
Ariz. Central	.10
Big Jim	1.31½
Lazy Boy	.06
Nellie	.18
Tom Reed	2.12½
United Eastern	4.25
United Western	.02

BOSTON EXCH.*	Feb. 20
Adventure	3⅛
Ahmeek	101
Algomah	.99
Allouez	66½
Ariz. Com., ctfs.	13⅛
Bonanza	.30
Butte-Balaklava	1⅛
Calumet & Ariz.	82½
Calumet & Hecla	560
Centennial	21
Copper Range	65⅛
Daly West	2⅛
Davis-Daly	6⅛
East Butte	14⅜
Franklin	8
Granby	86
Hancock	17
Hedley	16
Helvetia	.45
Indiana	2
Island Cr'k, com.	63
Isle Royale	34
Keweenaw	3⅛
Lake	14
La Salle	3⅛
Mason Valley	5⅛
Mass	14⅛
Mayflower	2⅛
Michigan	3⅛
Mohawk	83
New Arcadian	4⅛
New Idria	15⅛
North Butte	22⅞
North Lake	1
Ojibway	2⅛
Old Colony	2⅛
Old Dominion	64
Osceola	87
Quincy	93
St. Mary's M. L.	83
Santa Fe	1⅛
Shannon	9⅛
Shattuck-Ariz.	27
So. Lake	4⅛
So. Utah	.28
Superior	14⅛
Superior & Bost.	6⅛
Tamarack	56⅛
Trinity	4 7/16
Tuolumne	1
U. S. Smelting	59⅛
U. S. Smelt'g, pf.	50⅛
Utah Apex	2⅛
Utah Con.	21
Utah Metal	5⅛
Victoria	5⅛
Winona	4⅛
Wolverine	49⅛
Wyandot	1⅛

BOSTON CURB*	Feb. 20
Alaska Mines Corp.	1 3/16
Bingham Mines	8⅛
Boston Ely	.35
Boston & Mont.	.71
Butte & Lon'n Dev.	.22
Calaveras	4⅛
Calumet-Corbin	.01⅛
Chief Con.	2
Cortez	.30
Crown Reserve	.35
Crystal Cop.	1⅛
Eagle & Blue Bell	1⅛
Houghton Copper	1
Iron Cap Cop., pf.	16
Mexican Metals	.30
Mines of America	.2
Mojave Tungsten	.71
Nat. Zinc & Lead	.54
Nevada-Douglas	1 11/16
New Baltic	2⅛
New Cornelia	17⅞
Oneco	.60
Pacific Mines	.35
Rex Cons.	.32
Rilla	.06

SALT LAKE*	Feb. 20
Big Four	.77
Black Jack	.06½
Cardiff	6.00
Colorado Mining	.15½
Crown Point	.04
Daly-Judge	8.50
Emma Cop.	1.25
Empire Copper	1.90
Gold Chain	13½
Grand Central	.50
Iron Blossom	1.22½
Lower Mammoth	.04
May Day	.09
Moscow	.14
Prince Con.	1.22½
Seven Troughs	‡.03¾
Silver-King Coal'n.	3.17½
Silver King Con.	4.55
Sioux Con.	.11
So. Hecla	1.30
Uncle Sam	.04
Wilbert	.10
Yankee	.14

TORONTO*	Feb. 20
Bailey	.06
Beaver Con.	46½
Chambers Ferland	.15
Coniagas	4.20
La Rose	.51
Peterson Lake	.11
Right of Way	.04
T. & Hudson Bay	45.00
Temiskaming	.60
Wettlaufer-Lor.	.09
Dome Exten.	.30
Dome Lake	.28
Foley O'Brien	.70
Hollinger	5.10
Jupiter	.29
McIntyre	1.88
Newray	1.17
Porcu. Crown	.66
Schumacher	.68
Vipond	.47
West Dome	.30

STOCK QUOTATIONS—Continued

COLO. SPRINGS	Feb. 20
Cresson Con.	6.25
Doctor Jack Pot.	.08½
Elkton Con.	.10½
El Paso	.30
Findlay	.06
Gold Sovereign	.05
Golden Cycle	2.36
Granite	.59
Isabella	.20
Mary McKinney	.22
Portland	1.77
Vindicator	.75

LONDON	Feb. 6		
Alaska Mexican	£0	12s	6d
Alaska Tre'dwell	2	10	0
Burma Corp.	3	16	3
Cam & Motor	0	9	9
Camp Bird	0	5	6
El Oro	0	7	0
Esperanza	0	8	0
Mexico Mines	4	7	6
Nechi, pfd.	0	12	9
Oroville	0	15	0
Santa Ger t'dis	0	8	3
Tomboy	0	19	6

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1915	1916	1917	1915	1916	1917
January	48.855	56.775	75.630	22.731	26.960	36.682
February	48.477	56.755		22.753	26.975	
March	50.241	57.935		23.708	27.597	
April	50.250	64.415		23.709	30.662	
May	49.915	74.269		23.570	35.477	
June	49.034	65.024		23.267	31.060	
July	47.519	62.940		22.597	30.000	
August	47.163	66.083		22.780	31.498	
September	48.680	68.515		23.591	32.584	
October	49.385	67.855		23.925	32.361	
November	51.714	71.604		25.094	34.192	
December	54.971	75.265		26.373	36.410	
Year	49.684	65.661		23.675	31.315	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1916	1917	1916	1917	1916	1917
Jan.	24.008	28.673	88.083	131.921	116.167	142.895
Feb.	26.440		102.667		133.167	
Mar.	26.310		107.714		136.000	
April	27.895		124.319		137.389	
May	28.625		135.457		152.522	
June	26.601		112.432		137.455	
July	23.865		95.119		125.500	
Aug.	26.120		110.283		126.304	
Sept.	26.855		113.905		134.071	
Oct.	27.193		122.750		142.523	
Nov.	30.625		134.659		155.432	
Dec.	31.890		145.316		162.842	
Year	27.202		116.059		138.281	

Tin	New York		London	
	1916	1917	1916	1917
January	41.825	44.175	175.548	185.813
February	42.717		181.107	
March	50.741		193.609	
March	51.230		199.736	
May	49.125		196.511	
June	42.231		179.466	
July	38.510		168.357	
August	38.565		169.870	
September	38.830		171.345	
October	41.241		179.307	
November	44.109		186.932	
December	42.635		183.368	
Av. year	43.480		182.096	

Lead	New York		St. Louis		London	
	1916	1917	1916	1917	1916	1917
January	5.921	7.626	5.826	7.530	31.167	30.500
February	6.246		6.164		31.988	
March	7.136		7.375		34.440	
April	7.630		7.655		34.368	
May	7.463		7.332		32.967	
June	6.936		6.749		31.011	
July	6.352		6.185		28.137	
August	6.244		6.088		29.734	
September	6.810		6.699		30.786	
October	7.000		6.898		30.716	
November	7.042		6.945		30.500	
December	7.513		7.405		30.500	
Year	6.858		6.777		31.359	

Spelter	New York		St. Louis		London	
	1916	1917	1916	1917	1916	1917
Jan.	16.915	9.619	16.745	9.449	89.810	48.329
Feb.	18.420		18.260		97.762	
Mar.	16.846		16.676		95.048	
April	16.695		16.525		99.056	
May	14.276		14.106		94.217	
June	11.752		11.582		68.591	
July	8.925		8.755		50.750	
Aug.	8.730		8.560		51.587	
Sept.	8.990		8.820		52.095	
Oct.	9.829		9.659		54.159	
Nov.	11.592		11.422		56.023	
Dec.	10.665		10.495		55.842	
Year	12.804		12.634		72.071	

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. ⅛ Not reported.

Pig Iron, Pitts.	Bessemer‡		Basic‡		No. 2 Foundry	
	1916	1917	1917	1917	1917	1917
January	$21.60	$35.95	$18.78	$30.95	$19.70	$30.95
February	21.16		18.93		19.51	
March	21.81		19.20		19.45	
April	21.65		18.95		19.45	
May	21.78		19.11		19.58	
June	21.95		18.95		19.34	
July	21.95		18.95		19.20	
August	21.95		18.95		19.22	
September	22.88		19.58		19.53	
October	24.61		21.26		21.51	
November	30.07		28.18		26.55	
December	35.16		30.95		30.79	
Year	$23.88		$20.98		$21.15	

‡ As reported by W. P. Snyder & Co.